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THE USE OF OTOLITH MICROCHEMISTRY TO DISCRIMINATE ONCORHYNCHUS NERKA OF RESIDENT AND ANADROMOUS ORIGIN

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ABSTRACT

The role of resident forms of Oncorhynchus nerka in the refounding or maintenance of the anadromous form is unknown. Discrimination of forms that occur in sympatry is important to understanding this problem and, potentially, to the recovery of some seriously depressed anadromous stocks in Idaho. We used a wavelength-dispersive microprobe to sample the microchemistry of otoliths from O. nerka of known or assumed parental origin from several stocks (resident or anadromous female parent). We found patterns in strontium (Sr)/Calcium (Ca) ratios across otoliths that were consistent with changes in environmental chemistry associated with life history. We found the Sr/Ca ratio in otolith primordia of known anadromous origin fish to be significantly higher than those in fish of resident origin. The magnitudes of the Sr/Ca ratios we observed, however, were not consistent among lakes and differed from those observed in trout sampled by Kalish (1990). Differences among samples were clearly influenced by the chemistry of the local environment that could confound attempts to discriminate resident and anadromous forms in some lakes. Samples used to discriminate origin of 94 unknown outmigrants from Redfish Lake in Idaho were consistent with the presence of both resident and anadromous origin fish, but the two groups were not clearly resolved. We could not conclude that resident fish contribute to the production of anadromous adults. Our results do indicate, however, that an important component of anadromous behavior has been retained in the resident form. Otolith microchemistry has the potential to discriminate the origin of O. nerka, but more work on the inherent variability among and between stocks and on the influences of local spawning and incubation environments will be important to application of the method. The sensitivity of our results to variation in local water chemistry, and the relatively large differences in chemistry among the freshwaters in our sample indicate otolith microchemistry may be useful for other problems of stock discrimination.

Two and sometimes three forms of O. nerka occur together in lakes throughout much of the species range. Kokanee salmon, a resident form, typically spend their entire lives in a lake while sockeye salmon, an anadromous form, generally migrate to the ocean as 1 or 2 year old smolts and then return to the lake to reproduce. A residual form is represented by the progeny of anadromous adults that fail to migrate, remaining in the lake to maturity. The first two forms can give rise to each other (Ricker 1940, 1959, 1972; Foerster 1947; Rounsefell 1958; Nelson 1968; Scott 1984; Graynoth 1987; Foote et al. 1989) though genetic and at least partial reproductive isolation have occurred between them (Foote and Larkin 1988; Foote et al. 1989; Wood and Foote 1990). The residual form is an obvious necessity in the transition from anadromous to resident. It has been argued that the differentiation and isolation between the two primary forms may be evidence of sympatric speciation and that effective gene flow between forms may be severely restricted by selection against hybrids or kokanee salmon that attempt anadromy (Wood and Foote 1990; Foote et al. 1992; Taylor and Foote 1991). Sockeye salmon have clearly founded persistent kokanee salmon populations in recent history (Graynoth 1987). It is not clear whether the reverse is true in nature, although sustained populations of anadromous fish have been established from kokanee salmon under artificial circumstances (Kaeriyama et al. 1992). The role of polymorphism in O. nerka has been debated. Ricker (1940) suggested that the resident form might actually hasten the extinction of the anadromous form through competition if ocean or migratory survival of the latter was severely restricted. Others have argued that a resident form may allow persistence of sympatric anadromous forms during or following such restriction (E. Brannon, University of Idaho, Moscow, personal communications). Such strategies for persistence have been suggested in the resident/migratory polymorphism of other salmonids (Gross 1991; Titus and Mosegard 1992).

Numbers of adult anadromous sockeye salmon in the upper Snake River Basin have declined to near extinction in recent history. From 1981 to 1991, returns of anadromous adults to Redfish Lake in the head waters of the Salmon River have numbered from 0 to 50 fish. The Stanley Basin lakes in the headwaters of the Salmon River (Figure 1) once produced thousands of returning adults but even near the turn of the century those numbers seem to have been highly variable (Everman 1896). The Stanley Basin populations represented the longest inland migration (about 1450 km), highest elevation (about 1,980 m above mean sea level), and most southern (44 degrees S latitude) of naturally occurring sockeye salmon populations in the world. Variability in the populations may have been the result of existence on the extreme limits of the species range, but man has also played a role. In 1910, the construction of Sunbeam Dam about 30 km below the lakes severely restricted passage of adults and may have partially or even completely blocked the run to all lakes for 10 years (Bjornn et al. 1968). The dam was removed in 1934, and by the 1950's, several thousand anadromous adults were again returning to Redfish Lake (Bjornn et al. 1968), the largest of five lakes in the basin. Forty-five anadromous adults were observed in Alturas Lake in 1964 (Bjornn et al. 1968) but no other observation of anadromous fish has been documented in any of the other three lakes after the construction of Sunbeam Dam. Access to all lakes except Redfish Lake has been eliminated in recent years by dewatering of outlet streams or the presence of other migration barriers. Recent declines in sockeye salmon numbers to Redfish Lake are associated with similar declines in other migratory salmon in the Columbia River Basin and have been attributed to hydropower development in the Snake and Columbia rivers (Bowles and Cochnauer 1984; Raymond 1988). Despite the decline or elimination of the anadromous form, kokanee salmon persist in at least three of the lakes including relatively strong populations in Redfish and Alturas lakes (Rieman and Myers 1992).

The recovery and persistence of anadromous sockeye salmon in Redfish Lake following the removal of Sunbeam Dam may be explained in two ways. First, the run was maintained through a few anadromous adults that either managed to pass Sunbeam Dam and return to the lake or that spawned below the dam producing a riverine juvenile that migrated directly to the ocean without rearing in a lake. Second, the run was refounded by a resident form that successfully migrated to and returned from the ocean. There is limited evidence that kokanee salmon from Alturas and Redfish lakes do produce outmigrating fish (Bjornn et al. 1968; Idaho Department of Fish and Game (IDFG) unpublished data). The fish leaving these lakes leave at the same time and are of a similar size as sockeye salmon smolts (IDFG unpublished data). Juveniles leaving the lakes have migrated successfully to at least the lower Snake River reservoirs (about 750 km downstream) where they have been recovered at several of the dams and fish collection facilities (R. Keifer, Idaho Fish and Game personal communication). Whether these outmigrants occur in important numbers or contribute to anadromous returns is unknown.

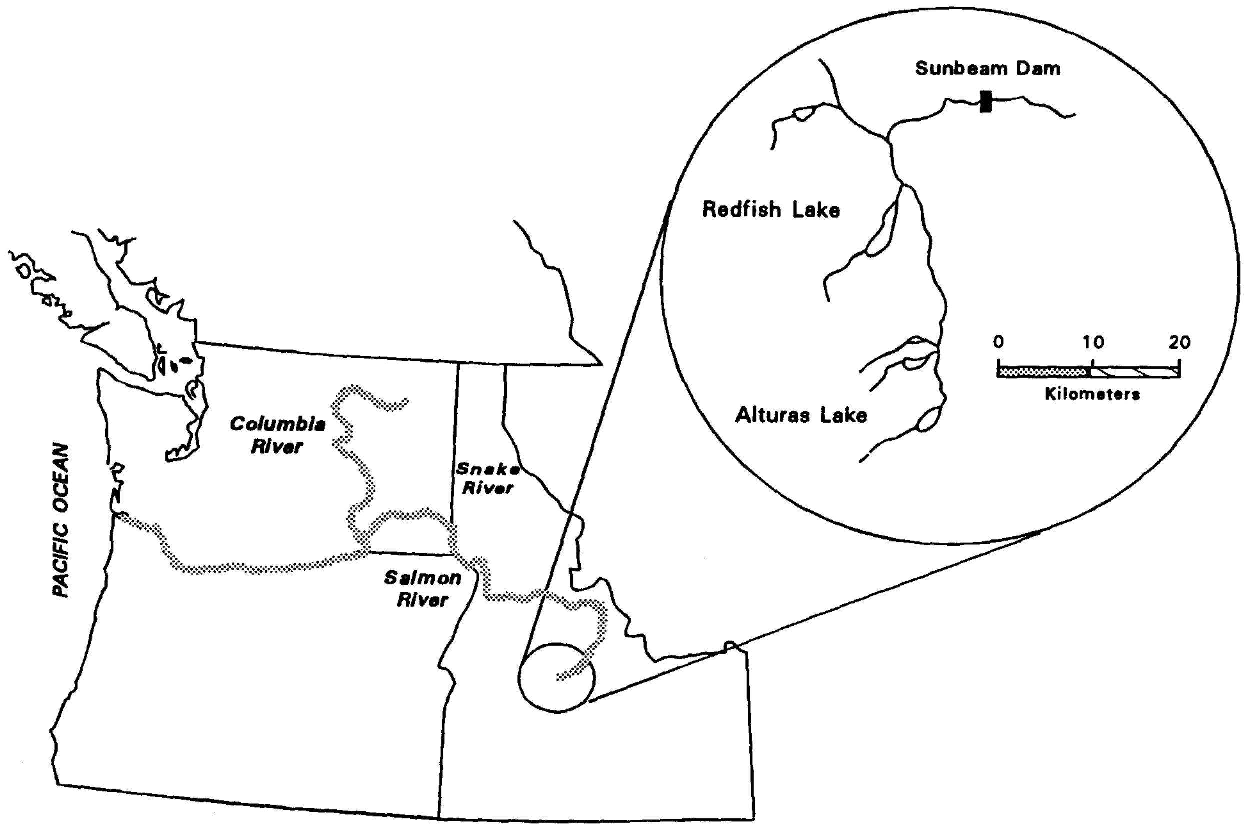

Figure 1. Location of Redfish and other Stanley Basin lakes in the Snake River and Columbia River basins.

In 1991, Snake River sockeye salmon were listed as an endangered species by the National Marine Fisheries Service (NMFS). The decision recognized only the anadromous form of O. nerka from Redfish Lake as the last remaining Snake River population of sockeye salmon. That stock was considered clearly endangered by virtue of the few returning adults (Waples et al. 1991). As part of emergency recovery efforts to form a captive broodstock, IDFG working with the NMFS began trapping juvenile fish that emigrated from Redfish Lake. Because only the anadromous form is considered under the species definition for the endangered listing, discrimination of the two forms is potentially important. Management for recovery of a successful anadromous population, however, must also consider the role resident fish may play in maintaining or refounding anadromous runs. It is possible that the resident forms represent alternative strategies for the maintenance of all O. nerka during periods of restriction of the anadromous form. Should enhancement and rebuilding be attempted with only the handful of anadromous fish and the resident origin fish ignored or even eliminated or should the resident form be incorporated into the recovery program?

Discrimination of origin and the relative contribution of different forms to the anadromous component in Redfish Lake could help answer these questions and guide future management.

Otolith microchemistry has been used in attempts to describe the environmental history of individual fish (Kalish 1989; Radtke 1989; Radtke et al. 1990). Kalish (1990) has shown that anadromous female brown trout Salmo trutta, Atlantic salmon Salmon salar, and rainbow trout O. mykiss may also pass a chemical signal in the form of elevated Sr to the otoliths of their progeny. Elemental Sr, similar in size and structure to Ca, may be substituted at a relatively low rate for Ca in the aragonite matrix of the otolith during growth (Kalish 1989, 1990). The incorporation of Sr may be influenced by the rate of growth, temperature, and stress (Kalish 1989; Radtke 1989; Radtke et al. 1990; Sadovy and Severin 1992) or a variety of factors that influence the amount of free Ca and Sr in the plasma, endolymph, or ova associated with the otolith in question (Kalish 1989). Although the Sr and Ca content in the otolith may be variable (Kalish 1989), Sr/Ca ratios in otoliths and ova do seem to reflect the relative amounts of Sr and Ca in the environment (Kalish 1990). In anadromous salmonids vitellogenesis is initiated while the female is still in the ocean. The Sr/Ca ratio of seawater is thought normally to be much higher than that found in freshwaters (0.0087 vs. 0.0019 on average), and therefore the Sr and Ca content in the ova from resident and anadromous forms may be very different (Kalish 1990). That difference in chemical composition may in turn be passed to resulting embryos. The multiple primordia of salmonid otoliths are the first calcified structures to form in the developing embryo and are present several weeks prior to hatch. The elemental composition of the primordia and the otolith that develop directly from yolk reserves may reflect the elemental composition of that yolk and ultimately the life history of the female parent. Kalish (1990) found that the chemical composition of sagittal otolith primordia could be used to clearly discriminate individual rainbow trout from female parents held in freshwater or seawater.

The purpose of this work was to determine whether otolith microchemistry can be used to discriminate O. nerka of resident and anadromous origin. To evaluate the technique, we obtained otoliths of known or assumed origin (anadromous or resident female parent) fish from several stocks of O. nerka. We hypothesized that a significantly elevated Sr/Ca signal should be evident in samples from the primordia of fish of anadromous origin relative to those of resident origin. After Kalish (1990), we expected that fish of anadromous origin should show a pattern of elevated Sr in the primordia, reduced Sr in the freshwater-growth region, and elevated Sr in the saltwater-growth region of otoliths consistent with changes of their environment due to anadromy. Following the analysis of known or assumed origin samples we used the technique in an attempt to characterize the origin of fish emigrating from and returning as anadromous adults to Redfish Lake.'

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METHODS

Otolith Samples

We obtained otoliths from the progeny of both resident and anadromous female parents at Redfish Lake in Stanley Basin, Idaho. A resident stock of kokanee salmon spawns in Fishhook Creek, a tributary to the lake. The Fishhook Creek stock can be clearly distinguished from anadromous fish on the basis of size and spawning time and location. In addition, all anadromous adults were trapped as they attempted to enter the lake in 1991, so the fish spawning in the lake or Fishhook Creek had to be fish that matured in the lake. Eggs were collected and fertilized at Fishhook Creek on two occasions in September 1991 as part of an independent research project. Embryos were transported directly to IDFG Eagle Island Hatchery where they were incubated, hatched, and reared. We sacrificed fish for otolith samples at several times between hatch and yolk absorption. Otolith samples from the Fishhook Creek kokanee salmon population represented at least six separate female parents.

One female and three male anadromous adults returned to Redfish Lake in 1991. As part of the endangered species recovery program the single female was spawned in captivity, and eggs were fertilized with sperm from each of the three males. The embryos were incubated, hatched, and reared in the same facility, in identical incubation chambers, and with the same water supply as were the resident fish. The anadromous origin embryos were brought into the hatchery about 1 month after those of resident origin, but because the water source is a well incubation, temperatures did not vary significantly between the two groups. We obtained otoliths only from mortalities that occurred during incubation and rearing. Our samples represented all of the three matings.

For additional comparison, we obtained otoliths from _O. nerka_ of known or assumed origin from several other sources. We collected otoliths from the kokanee salmon adults spawning in Fishhook Creek at Redfish Lake. Although the Fishhook Creek adults could have been residual progeny of anadromous adults, they are probably reproductively isolated from the anadromous stock. Kokanee salmon spawning in Fishhook Creek spawn at least 1 month earlier than the known anadromous fish which have only been observed spawning along the lake shore. Because of the isolation from the known anadromous spawning site and time, we assumed that the Fishhook Creek samples represented fish of resident parent origin. We collected otoliths from kokanee salmon in Alturas Lake which is about 25 km from Redfish Lake. Although Alturas Lake once supported an anadromous run, access to anadromous fish is blocked and none are known to have returned to the lake in at least 20 years. The Alturas Lake samples clearly represent samples of resident parent origin but from a distinct watershed in the Stanley Basin. NMFS provided samples of anadromous origin adults and outmigrating smolts from Wenatchee Lake tributary to the Columbia River in Washington. Resident origin fish were not available from Wenatchee. The Canadian Department of Fisheries and Oceans (CDFO) provided samples from anadromous adults and resident adults from Takla Lake in the headwaters of the Fraser River. The parental origin of the Takla fish is not certain, but phenotypic and genetic information were used to characterize the fish as resident, residual (remaining in the lake but originating from an anadromous female parent), and anadromous origin (C. Foote and C.C. Wood, CDFO, Nanaimo, British Columbia, unpublished data).

Otolith samples of unknown parental origin were available from juvenile fish that emigrated from Redfish Lake. In May of 1991, 861 of an estimated 4,500 emigrants were trapped in the outlet of the lake. Redfish Lake outmigrant samples consisted of fish that died at the trap site and hatchery mortalities from fish that were transported and held at IDFG Eagle Island Hatchery. We also obtained otoliths from the four anadromous adults that returned to the lake and were spawned in October 1991.

All otoliths were stored dry in plastic micro-centrifuge vials until preparation for analysis.

Analysis

Otoliths were cleaned in deionized water and dried before mounting. Our initial preparation of otoliths from juvenile fish followed Kalish (1990). The samples were mounted sulcus side up on glass slides with Crystal Bond 509 (Aremco Products Inc.). We ground samples in the sagittal plane to the approximate level of the primordia with 1,200 grit wet-dry paper. The much larger otoliths from adult fish were initially mounted sulcus side down and ground in the sagittal plane to a level near the primordia with 600 grit and then 1,200 grit paper to provide a thinner sample and better optical properties. The otoliths were then heated and turned sulcus side up and ground to near the primordia as with the juvenile preparations. We ground all (adult and juvenile) samples to the precise level of the central primordia with 5.0 $_p$ paper (Buehler Inc.). We finished samples by hand polishing on 1.0 p and then 0.05 p alumina paste (Buehler Inc.). All samples were washed with deionized water in an ultrasonic cleaner and then photographed at magnifications of 140 and 280 X. Photographs were used to "map" the sample and guide the selection of microprobe sites. Immediately before final analysis, samples were again washed with deionized water, air dried, and then coated with a 200 A carbon layer for surface conductivity.

Elemental analyses were done with a Cameca SX-50 wavelength dispersive microprobe at Oregon State University. Our analyses followed the general procedures outlined by Toole and Nielsen (1992). All of our analyses were conducted using a 15 KV, 50 nA, and 5 $_p$ diameter, electron beam. Standards for Sr and Ca were strontiantite ($SrCO_3$-USNM R10065) and calcite ($CaCO_3$-USNM 136321). Because we were trying to maximize precision, we used a long counting time (40 s), analyzing each element simultaneously. We report Sr/Ca ratios as normalized mole fractions (Toole and Neilsen 1992) which are equivalent to the atomic ratios reported by Kalish (1989). One potential problem with otolith analysis is the effect of beam damage (Kalish 1990). Under exposure to the electron beam, carbonate and organic material will break down, changing the composition of the area under the beam. Specifically in the case of otoliths, the concentration of Ca and Sr will increase because of the loss of CO_2 and H_2O by volatilization. Our use of long counting times and high beam currents thus precluded analysis for absolute abundances of the individual elements (Kalish 1990; Toole and Nielsen 1992). The technique developed by Toole and Nielsen (1992) and used in this study is based on the assumption that Sr and Ca are equally refractory under exposure to the electron beam. Given that assumption, the ratio of Sr to Ca at the sample site would remain constant throughout the period of beam exposure. To test this assumption we analyzed a single site on a single otolith repeatedly 10 times. The results (Table 1) show no systematic change in Sr/Ca ratio with sequential samples. The coefficient of variation (CV), calculated as the $SD_{S/Ak}$•Mean Sr/Ca'', for the 10 samples was approximately 0.11.

We classified sampling locations on individual otoliths as follows: (1) Primordia - sites directly in the primordia or in nuclear material immediately adjacent to the primordia; (2) Nucleus - the area of growth between the central and distal primordia and between the primordia and point of hatch; (3) Posthatch - the area between the point of hatch and yolk absorption; (4) Freshwater - the area between the point of yolk absorption and the point of saltwater entry for anadromous fish or the last *annulus* for resident fish, in most samples these sites were in the summer growth region preceding the first *annulus;* and, (5) Saltwater - the summer growth region preceding the last *annulus* on otoliths of anadromous adults.

All otoliths were sampled in the primordia. Sample sites in the nucleus were used only on initial analyses where we ran a transect of probe sites from the primordia out toward the edge of the otolith. The transects and samples in freshwater and saltwater areas were used only to determine whether patterns in Sr/Ca ratio were consistent with those anticipated based on anadromy and resulting change of environment.

Samples in the posthatch location were originally included only on the otoliths of known origin fry incubated at the IDFG Eagle Island Hatchery. Size of the otolith at the early age of sampling (between hatch and yolk absorption) precluded any other sampling locations outside the nucleus. We assumed otolith composition out to the point of yolk absorption would be consistent with that in the primordia reflecting only the parental influence on yolk composition. Preliminary results indicated that was not the case. We, therefore, included additional samples in the posthatch location for otoliths from fish not held or incubated in the hatchery to determine whether the hatchery environment influenced otolith composition in the posthatch location.

Except for the transect samples, we located six probe sites within each sampled location on each otolith. Analyses of individual sites with high organic content, or where there were surface flaws, were eliminated from the data set. Such results were identified by their low total ion concentration (<80 % wt carbonate). A total of nine otoliths out of the entire sample were limited to five sites in the primordia.

We analyzed water chemistry to determine whether the chemistry of otoliths was related to the chemistry of the environment in which the otolith developed. Water samples were collected from each of the freshwater sites, except Takla Lake, where fish were incubated or reared. Samples were analyzed by inductively coupled plasma atomic emission spectrometry, according to US Environmental Protection Agency method 215.1 (USEPA 1983) for Ca and Standard Methods method 303 (APHA 1989) for Sr. Detection limits for both elements were considered to be 10 μg 1^{-1}.

Table 1. Elemental Sr/Ca ratios of ten sequential micro-probe samples of a single site on a single otolith.

	Sample in order of analysis				
Sample	1	2	3	4	5
Sr/Ca ratio	0.00232	0.00176	0.00214	0.00241	0.00202
Sample	6	7	8	9	10
Sr/Ca ratio	0.00213	0.00194	0.00237	0.00212	0.00254

RESULTS

Samples of Known or Assumed Origin

Microprobe transects run on otoliths of known or assumed origin showed patterns consistent with our expectations. Transects on otoliths from sockeye salmon smolts and adults from Wenatchee Lake showed intermediate and consistent Sr/Ca ratios in the primordia and nucleus, reduced Sr/Ca ratio in the freshwater-growth region, and high ratios in the saltwater-growth region (Figure 2). Transects run on kokanee salmon assumed to be of resident origin in Redfish Lake were consistently low at all sites and locations. Our results follow the observations of Kalish (1990) and are consistent with anticipated changes in the Sr/Ca content of the environment experienced throughout the life of each fish (i.e., low or high in the egg influencing the otolith through hatch, low in the freshwater environment, and high in the ocean).

posthatch

The Sr/Ca ratios in the primordia of anadromous origin otoliths from Redfish Lake were clearly elevated relative to samples of resident origin (Figure 3A). The distribution of all sample sites in the two groups overlapped, but the distribution of means for individual otoliths did not (Figure 3B). The CV among sites within individual otoliths ranged from about 0.04-0.20. None of the samples of resident origin produced a mean Sr/Ca ratio higher than 0.00080 (range 0.00042-0.00080); and only one sample of anadromous origin produced a ratio lower than 0.00140 (range 0.00114-0.00201). Samples in the regions of these otoliths were elevated relative to samples in the primordia of both groups (Figure 3C). Analysis of variance on log $(x + 1)$ transformed data indicated an effect of both origin ($p < 0.001$) and sample location ($p < 0.001$) on the Sr/Ca ratio with a significant interaction ($p < 0.001$).

The differences in Sr/Ca ratios between the primordia and posthatch locations of the known origin samples (Figure 3B and 3C) were not consistent with our expectations. We believed that otolith content would be influenced only by the Sr/Ca content of the yolk (and ultimately the life history of the female parent). Our initial transects (Figure 2) supported that expectation. The differences we observed in our known samples, however, indicated that the artificial environment where our embryos were incubated and hatched may have influenced the otolith content following hatch. For that reason, we included samples in both locations on additional otoliths from Redfish Lake kokanee salmon that had incubated, hatched, and reared only in the lake. The Sr/Ca ratios in those samples (0.00053-0.00075) were similar to levels observed in the primordia of resident origin fish (Figure 4) and did not differ significantly ($p = 0.280$) between the primordia and posthatch sample locations. Additional samples in freshwater locations from Redfish Lake kokanee salmon were similar to observations in both the primordia and posthatch locations (Figure 4).

With the exception of Alturas Lake, samples in otolith primordia and freshwater locations from populations other than Redfish Lake produced Sr/Ca ratios consistent with our expectations based on known or assumed origin (Figure 5). Samples in the primordia of anadromous adults and smolts from

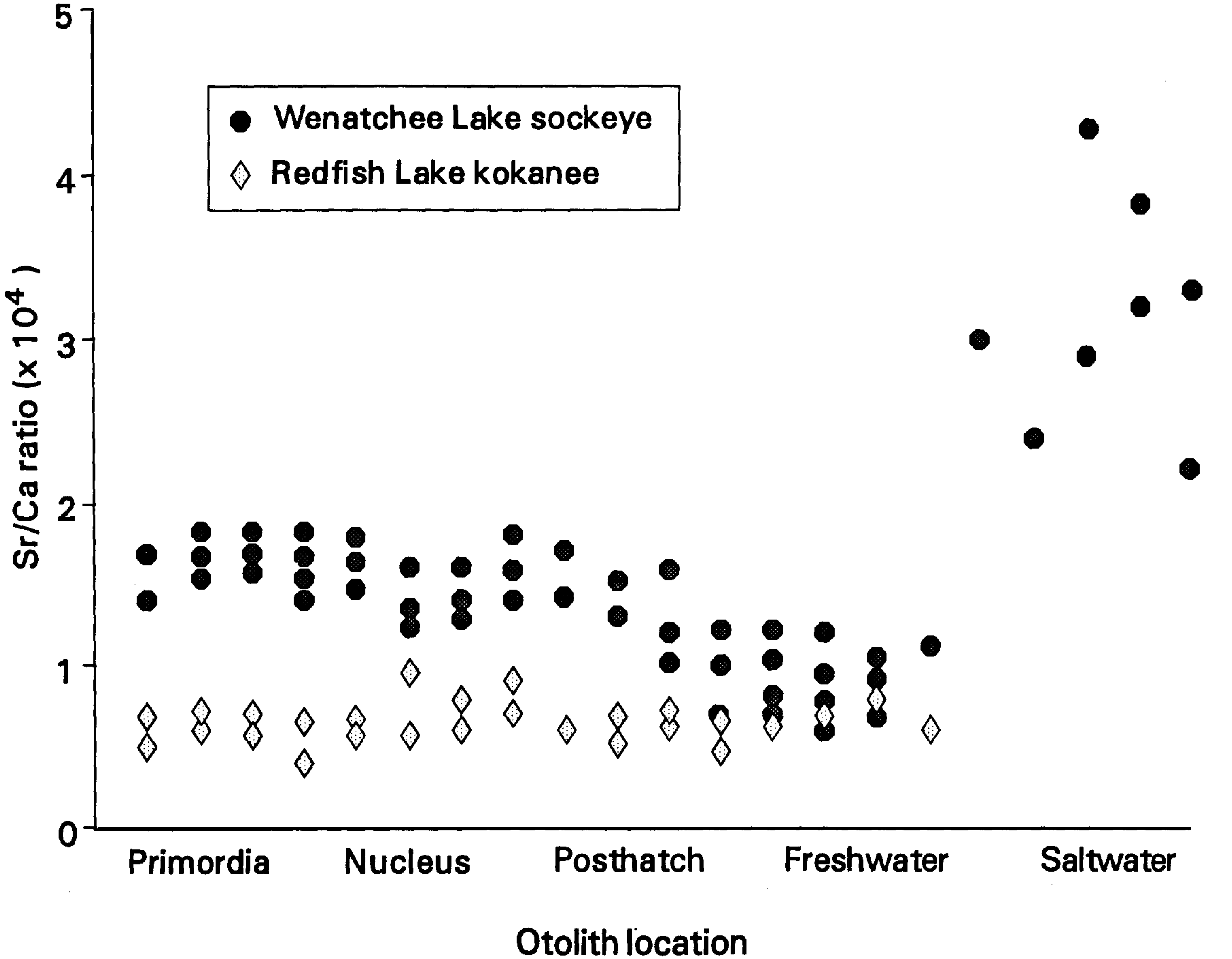

Figure 2. Sr/Ca ratios from microprobe transects across five general locations on otoliths from adult resident Lake) and anadromous (Wenatchee Lake) O. nerka.

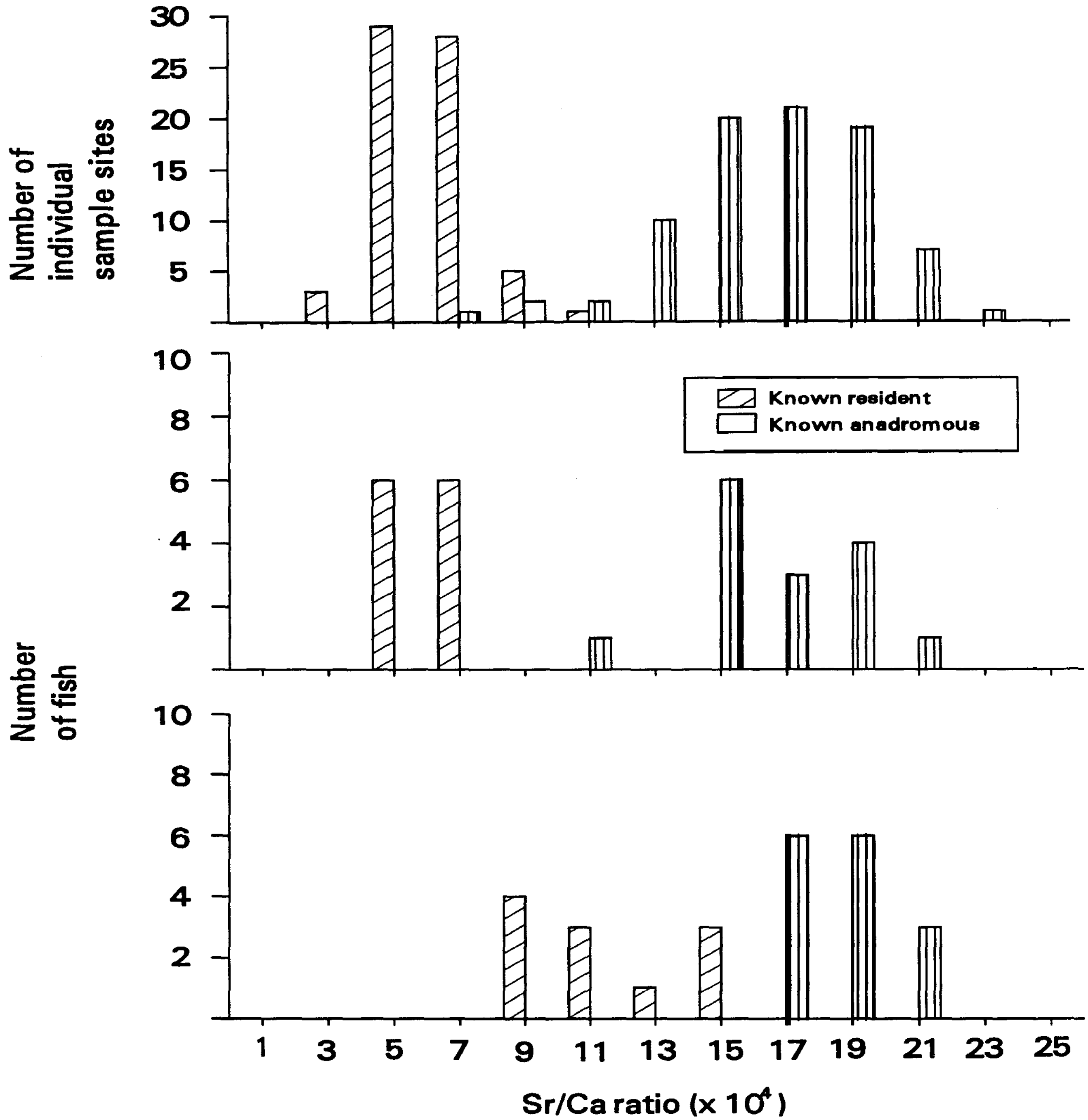

Figure 3. Sr/Ca ratios from microprobe sites in primordia and posthatch locations on otoliths of O. nerka of known resident or anadromous origin. All fish were the progeny of fish spawned at Redfish Lake and were incubated at the IDFG Eagle Island Hatchery. A represents all sample sites in the primordia for all fish; B represents the means of sample sites in the primordia for individual fish; C represents the means of sample sites in the posthatch location for individual fish. Numbers on the x axis represent the midpoint of bins used in the frequency distributions.

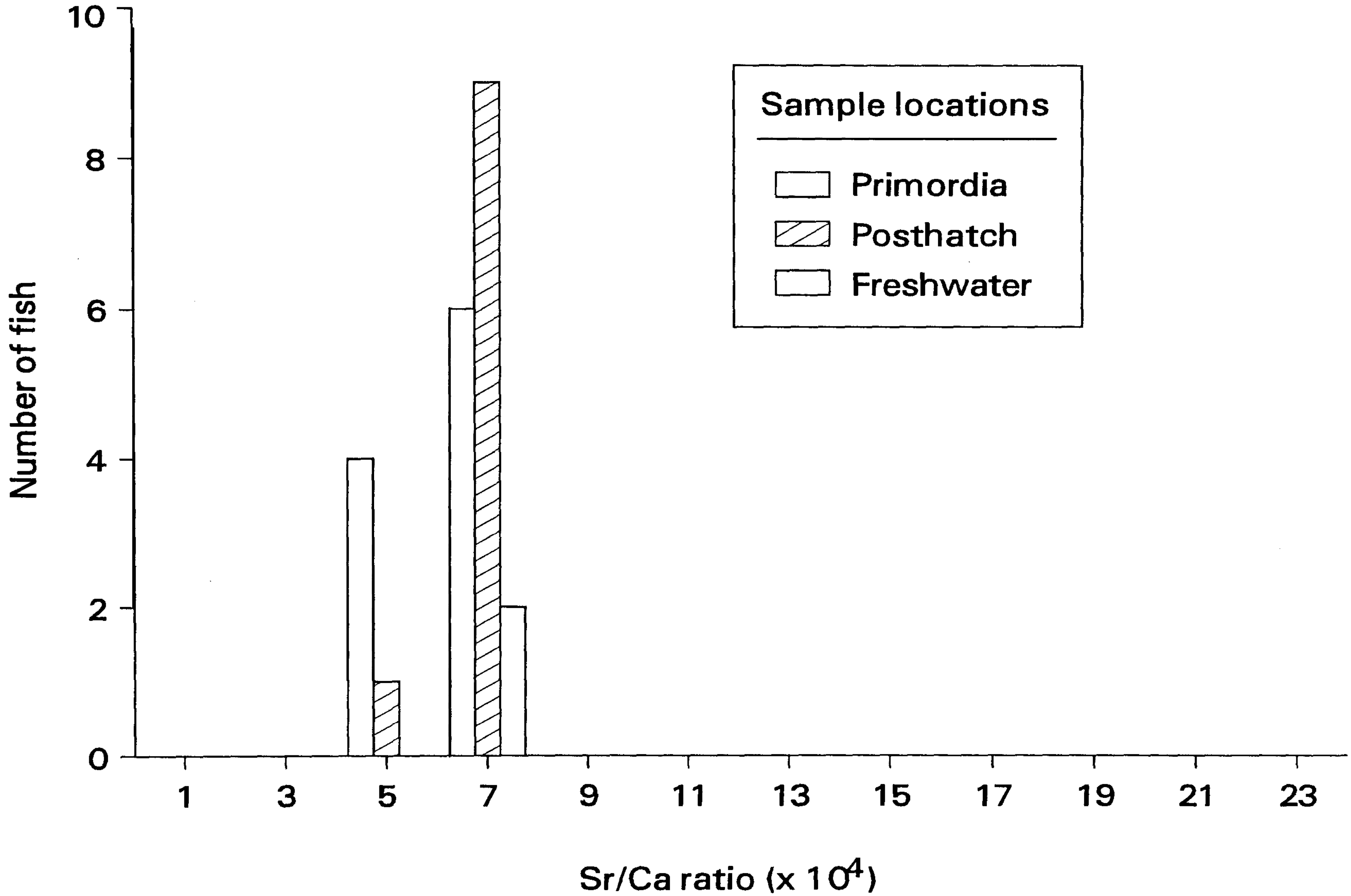

Figure 4. Sr/Ca ratios from microprobe sites in the primordia, posthatsch, and freshwater locations of individual O. nerka collected from the wild in Redfish Lake. All fish were assumed to be of resident origin. Numbers on the x axis represent the midpoint of bins used in the frequency distributions.

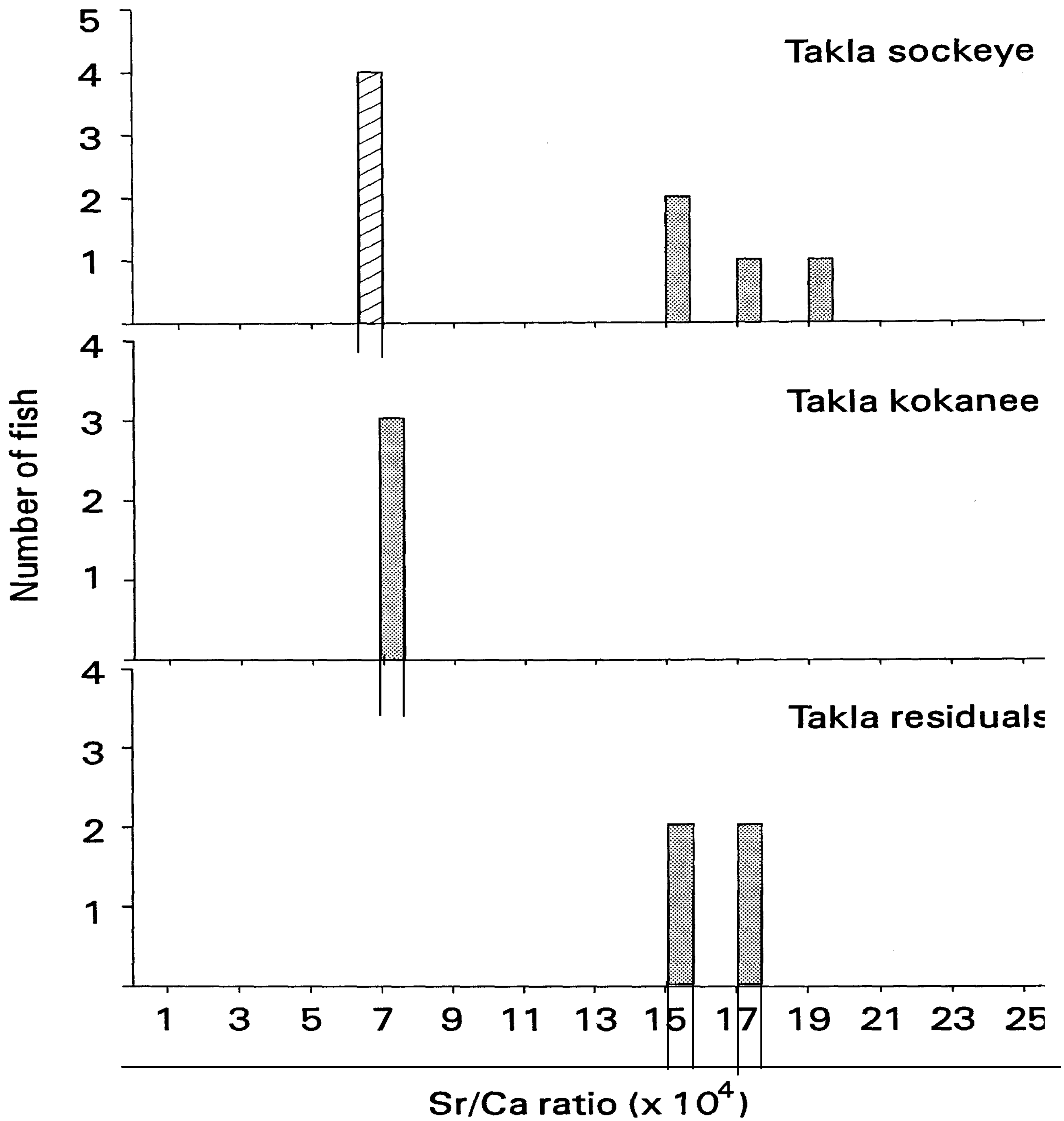

Figure 5. Sr/Ca ratios from microprobe sites in the primordia and freshwater locatior on otoliths of individual O. nerka from Wenatchee, Takla, and Alturas lakes. The Wenatchee samples are of anadromous origin; the Takla samples were assumed to be of resident, anadromous but residual, and anadromous oriç and the Alturas samples are of resident origin. Freshwater sites from the Takla fish were limited to a single individual. Numbers on the x axis repres the midpoint of bins used in the frequency distributions.

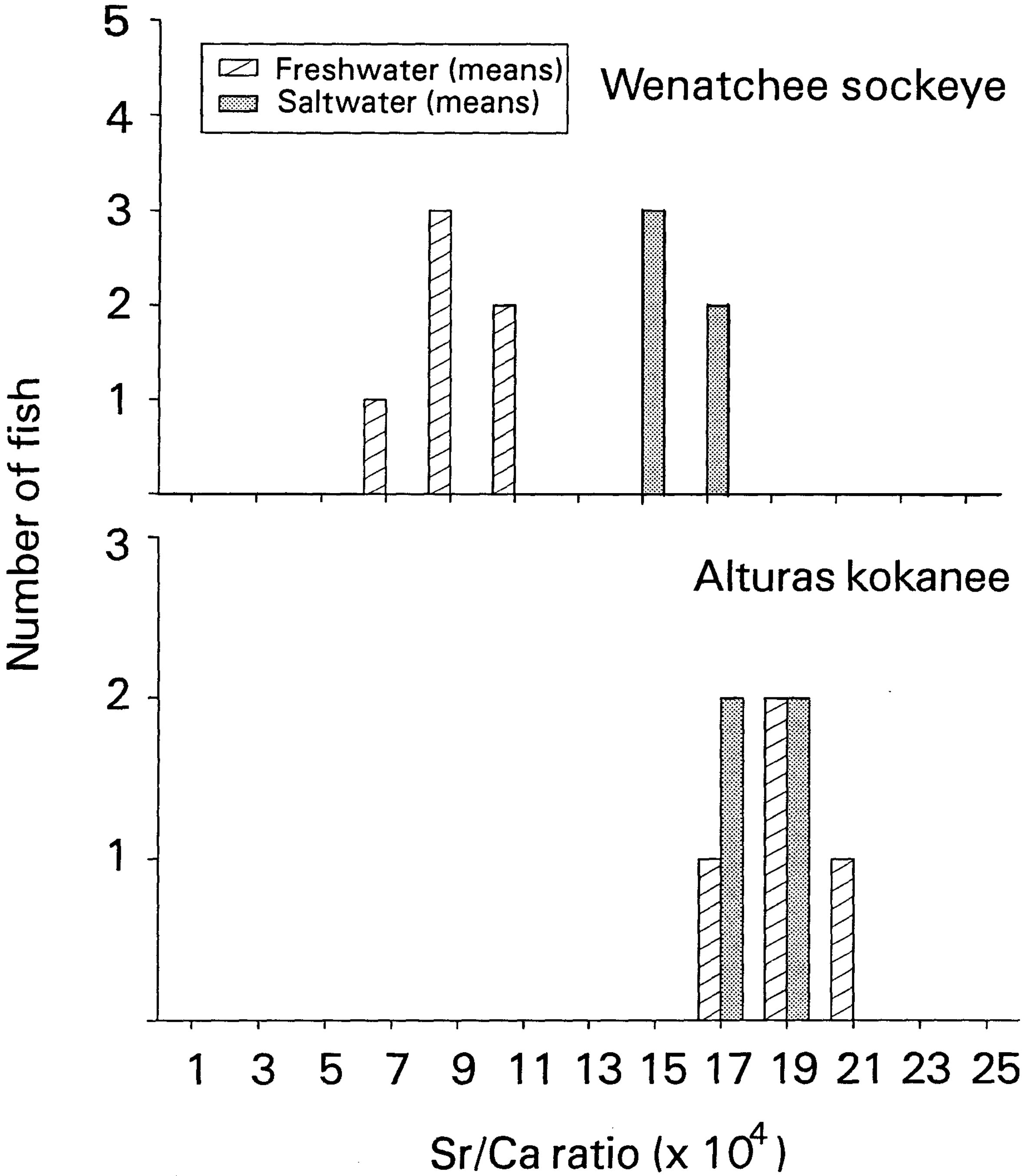

Figure 5. (continued)

Wenatchee Lake (0.00148-0.00174) fell in the same range as those of anadromous fish from Redfish Lake. Samples in primordia of adults from Takla Lake assumedto be either anadromous or residual (but of anadromous origin) were also high (0.00146-0.00186) and similar to the Wenatchee Lake and Redfish Lake samples. Samples in the primordia of kokanee salmon from Takla Lake were low (0.00062-0.00070) and again similar to resident samples from Redfish Lake. The samples in both primordia and freshwater locations from Alturas Lake were high (0.00155-0.00204). Samples in the Alturas Lake primordia were similar to observations from anadromous origin fish (Figure 5). Samples in the Alturas Lake freshwater locations were higher than those observed in freshwater locations from any other samples.

Samples of Unknown Outmigrants from Redfish Lake

We completed microprobe analyses on otoliths from 94 individual O. nerka that migrated out of Redfish Lake in May 1991. The range of mean Sr/Ca ratios in primordia of individual fish was similar to that observed among pooled samples of both resident and anadromous origin (Figure 6). Two modes were evident in samples from freshwater locations. However, all freshwater samples higher than 0.00076 were taken from fish that had been held in and died at the IDFG Eagle Island Hatchery. The sample locations fell in the area of growth that occurred in the hatchery, and thus represent incorporation of Sr that occurred in the hatchery and not in the lake. The range of means from freshwater locations that represented growth in the lake was much narrower and consistent with other freshwater samples except those from Alturas Lake. Two modes were evident in the primordia means suggesting fish of both resident and anadromous origin were present in the sample. The data did not break into two clearly discrete groups, however, that would allow an obvious classification of origin for all fish. Approximately one-third (35%) of the samples fell into the range between 0.00080 and 0.00140, while 29% and 36% of the samples fell above and below that range, respectively.

The CV among sites within the primordia ranged from about 0.10 to 0.30 (Figure 7). The variation among sample sites in individual otoliths tended to be higher than we observed in the sequential samples at the single site on a single otolith (CV about 0.1) or among sites in the primordia of known individuals (0.04-0.20). The variation among sites also tended to be higher in samples that fell in the mid-range between the two modes (Figure 7).

Fork length for our sample of fish emigrating from Redfish Lake ranged from 80-115 mm. Fork length was correlated with the Sr/Ca ratio in otolith primordia ($r = 0.51$, $p < 0.001$). The data suggest, that fish with the highest Sr/Ca ratios also were among the largest leaving the lake (Figure 8). Eighteen of 24 fish with Sr/Ca ratios >0.0014 were larger than 99 mm, while 20 of 26 fish with ratios <0.0008 were less than that length. A Kolmogrov-Smirnov test for differences in the length frequency distributions for fish with Sr/Ca <0.0008 or higher >0.0014 was significant ($p < 0.001$).

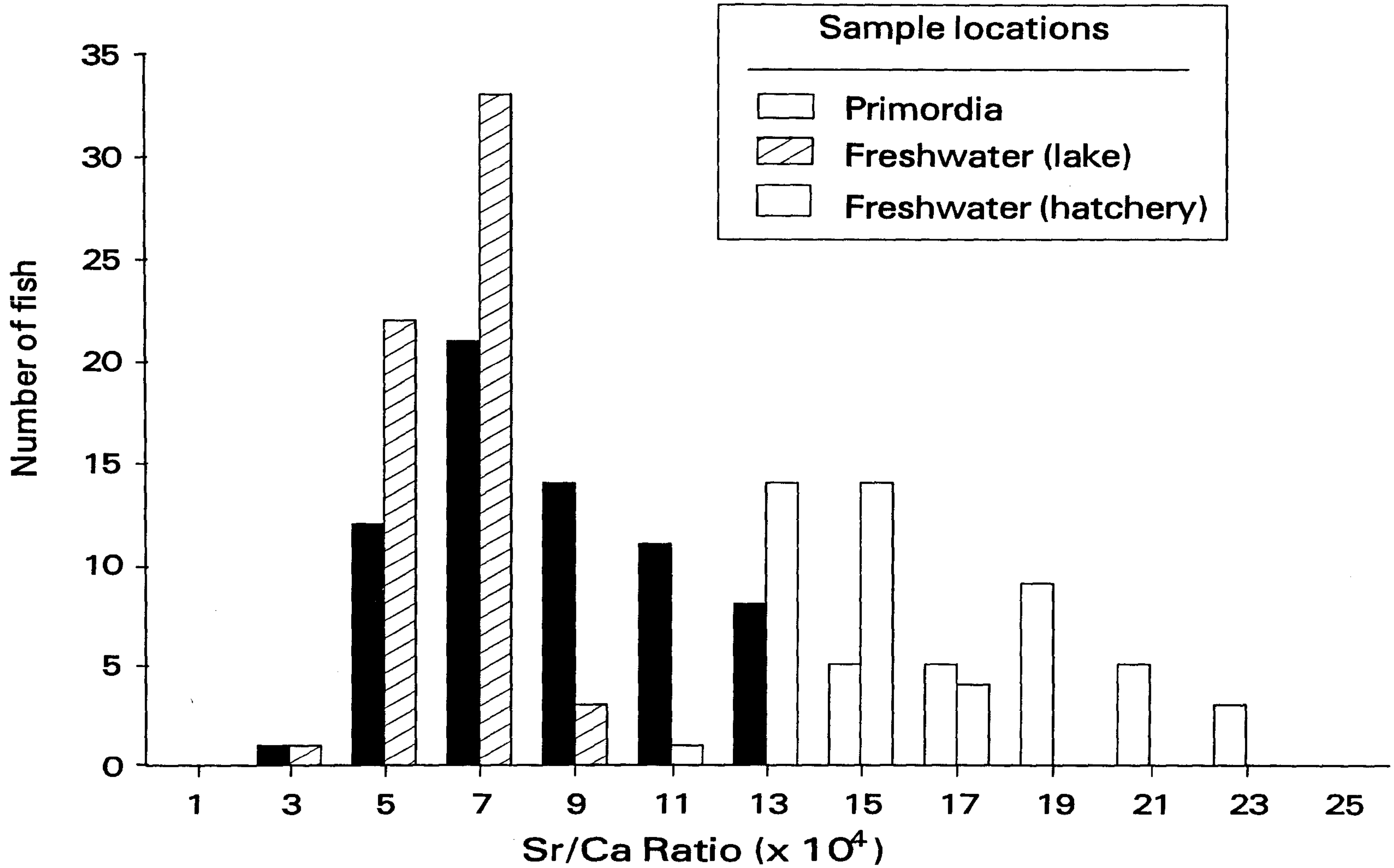

Figure 6. Sr/Ca ratios from microprobe sites in the primordia and freshwater locations on otoliths of individual O. nerka trapped while migrating out of Redfish Lake in May 1991. Freshwater sample locations are separated by individuals that died at the trapping site (lake) and those that were hel at the Eagle Island Hatchery (hatchery). Numbers on the x axis represent the midpoint of bins used in the frequency distributions.

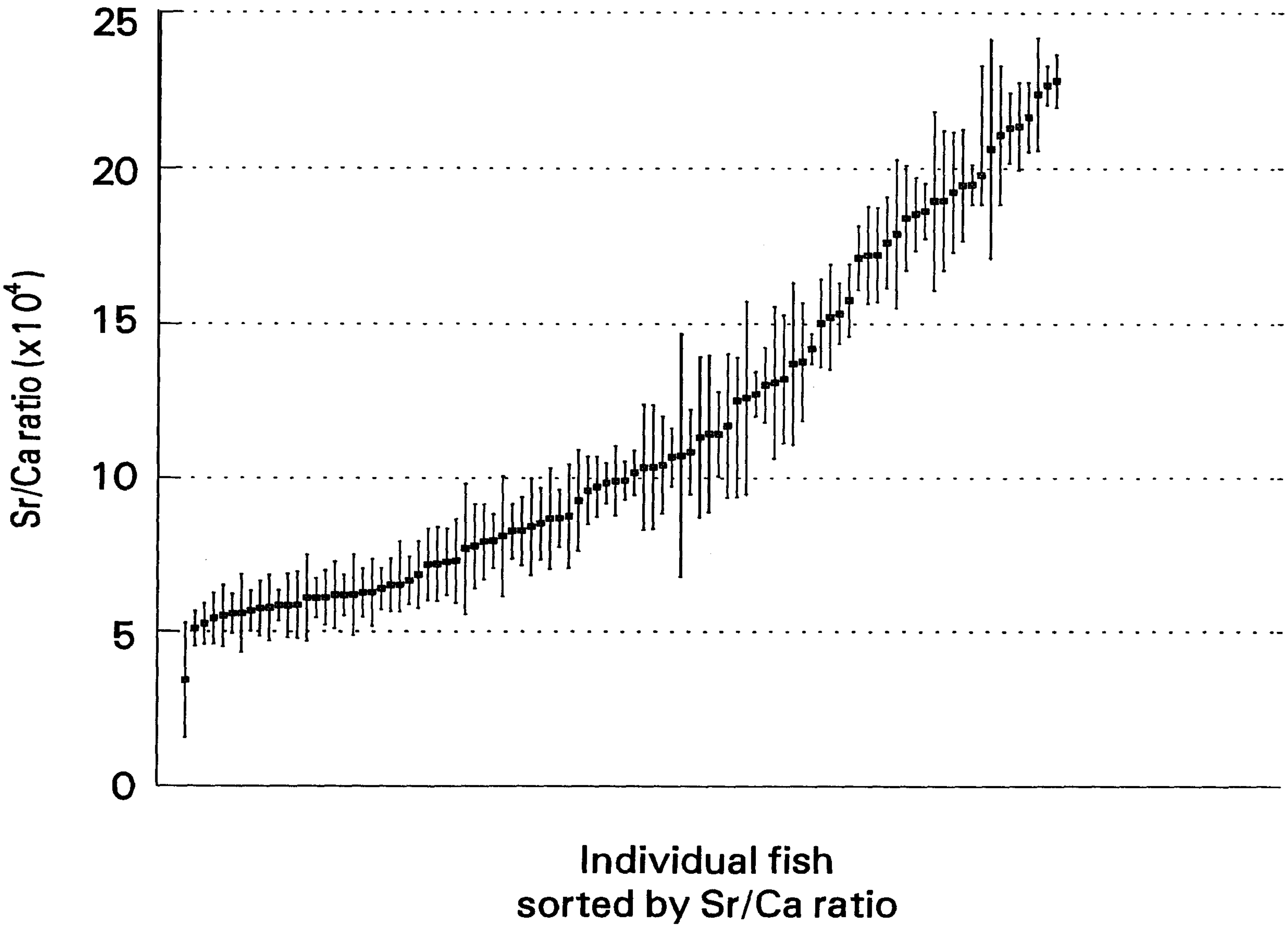

Figure 7. Mean and CV of Sr/Ca ratios from microprobe sites in the primordia on otoliths of individual O. nerka trapped while migrating out of Redfish Lake in May 1991.

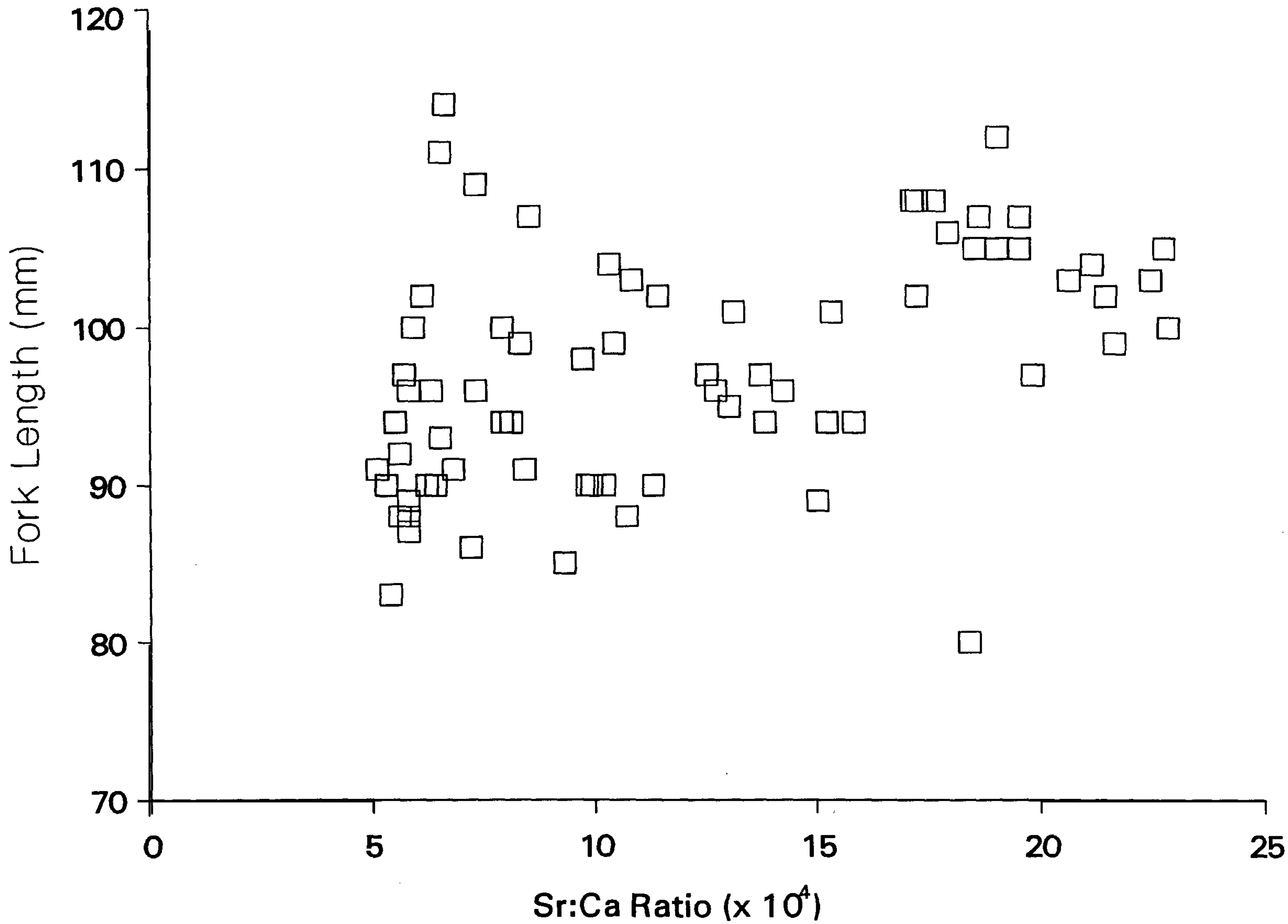

Figure 8. Relation of total length at migration and the mean elemental ratio of Sr/Ca in primordia for *O. nerka* trapped while migrating out of Redfish Lake in May 1991.

Alternatively, of the samples with lengths longer than 99 mm, 61% (19/31) could be classified as of anadromous origin (Sr/Ca > 0.0014) while 16% and 22% would be classified as unknown or resident, respectively.

The time of emigration for fish in our sample ranged from day 128-158 (Figure 9). We found no pattern in date of emigration associated with Sr/Ca ratios in the otolith samples.

The Sr/Ca ratios in primordia of the four anadromous fish that returned to Redfish Lake in 1991 fell in the range observed for samples of known anadromous origin (Figure 10).

Water Chemistries

Concentrations of Sr and Ca varied substantially among the waters sampled (Table 2). The resulting Sr/Ca ratios ranged from <0.0012-0.0061. We found a direct relationship between the Sr/Ca ratio in primordia or freshwater locations that were associated with each of the water sources and water chemistry (Figure 11).

DISCUSSION

Analysis of the Sr/Ca content of otoliths with a wavelength dispersive electron microprobe has the potential to discriminate sympatric populations of resident and anadromous O. nerka. Differences in our known samples from Redfish Lake were clear, and the expected patterns were evident in other populations as well. The Sr/Ca ratios we observed in freshwater and saltwater growth regions (Figure 2) were similar to those observed among the three species represented by Kalish (1990). The relative differences we observed in the Sr/Ca ratios of primordia from resident and anadromous origin fish were also similar to those observed by Kalish (1990). The available data suggest different salmonids incorporate Sr into the otolith in similar fashion, and analysis of Sr content in otoliths of migratory salmonids including sockeye salmon can provide important information on life history patterns.

There were differences, however, in our results and those of Kalish (1990). The absolute magnitudes of our ratios were lower than the detailed observations of Kalish (1990) in rainbow trout. Our sample means in otolith primordia of resident origin ranged from about 0.0004-0.0008, and in primordia of anadromous origin from 0.0011-0.0020. Kalish observed ranges of about 0.0007-0.0017, and 0.0022-0.0052 for the same two groups, respectively.

A variety of factors, including stress may influence the mobilization and availability of Ca and Sr in the blood plasma vitellogenin, the resulting yolk proteins of developing ova, and, ultimately, in the substitution of Sr for Ca in the aragonite matrix of developing otoliths (Kalish 1989). It should not be surprising that we found differences in the absolute magnitude of Sr in primordia

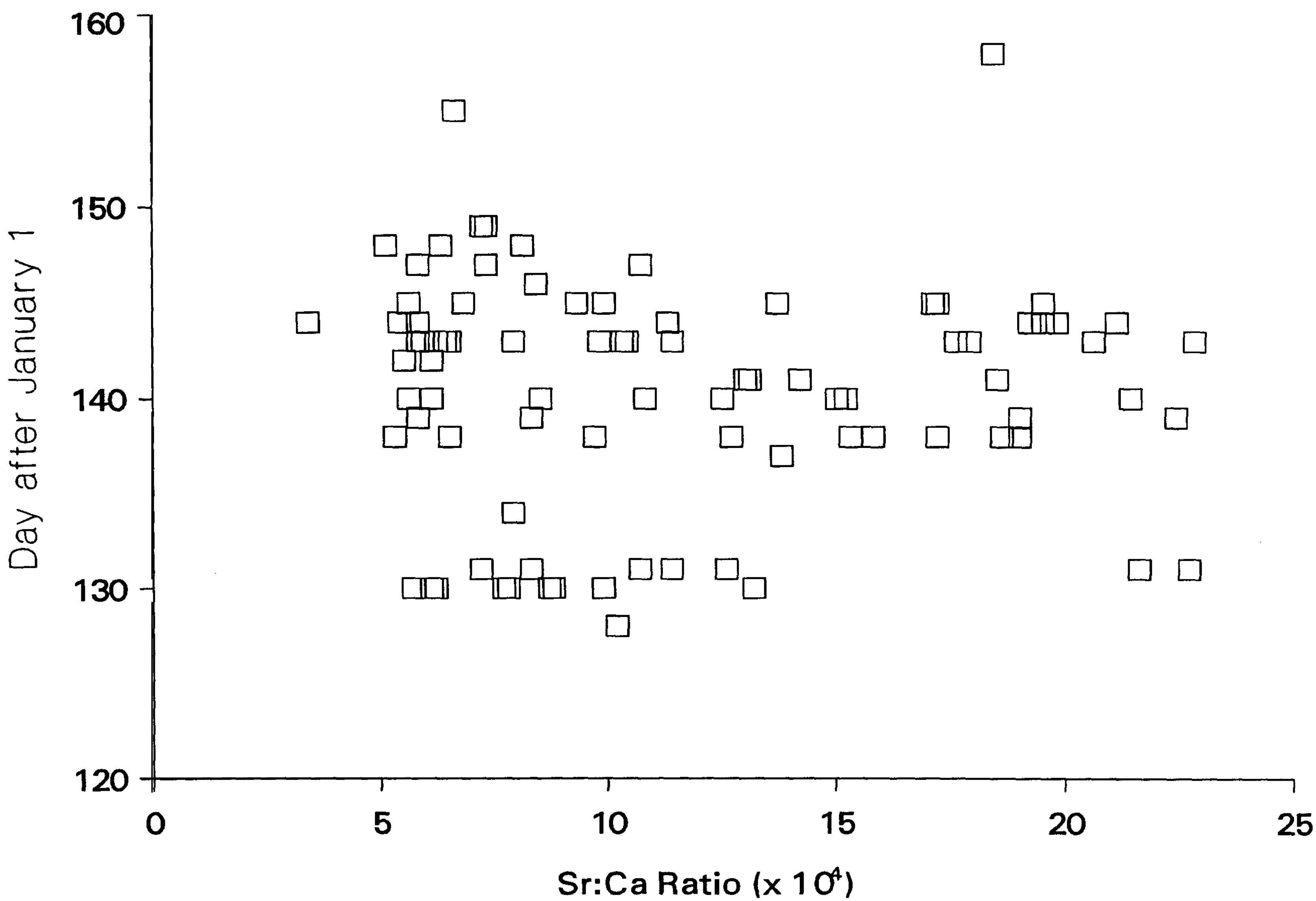

Figure 9. Relation of date of migration (day from January 1) and the mean elemental ratio of Sr/Ca in primordia on otoliths of *O. nerka* trapped while migrating out of Redfish Lake in May 1991.

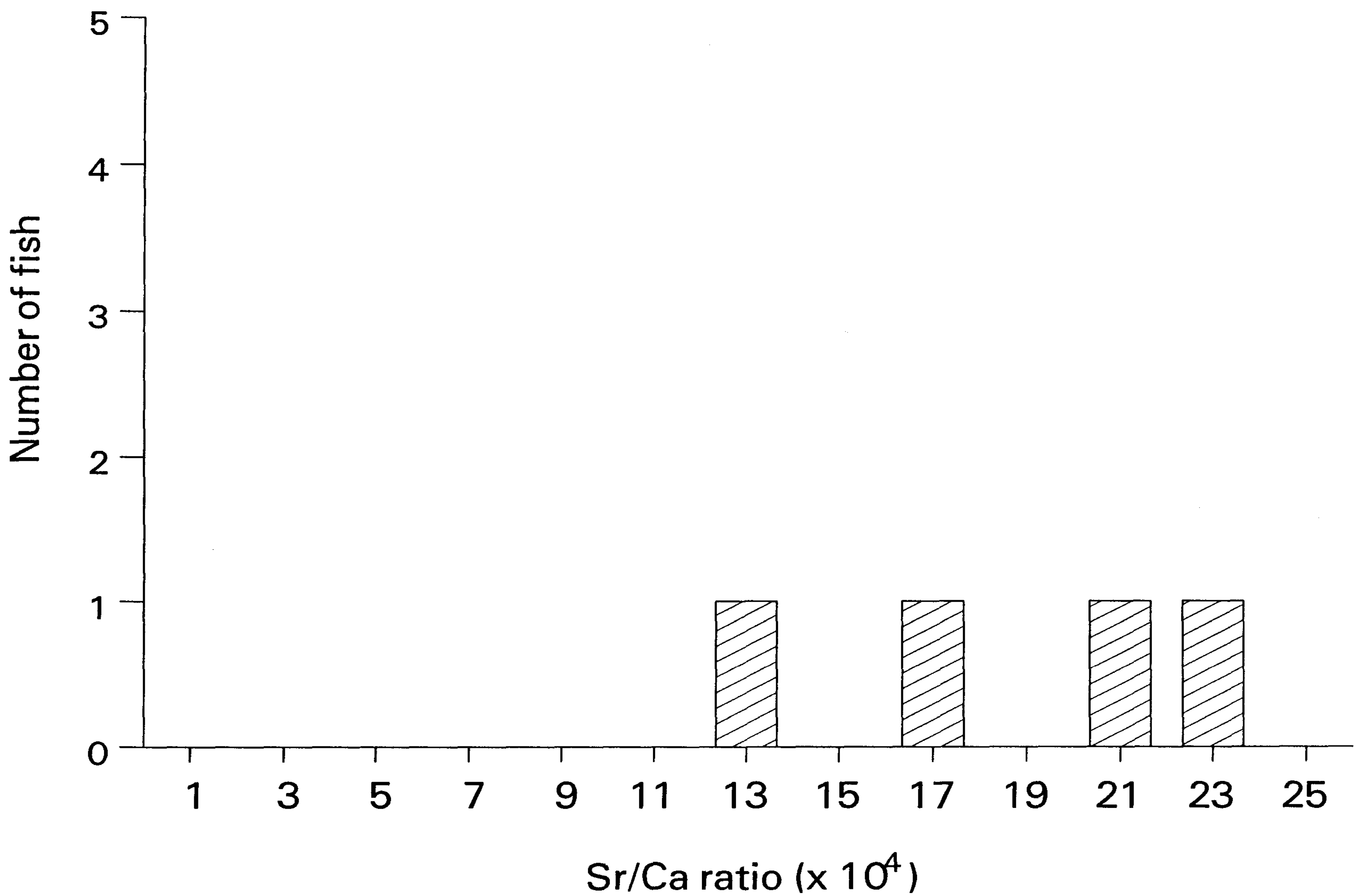

Figure 10. Sr/Ca ratios from microprobe sites in the primordia of individual anadromous adult O. nerka that returned to Redfish Lake in 1991.

Table 2. Concentration[a] and elemental ratios of strontium and calcium in four lakes and the IDFG Eagle Island Hatchery water supply. Sample sizes are shown in parentheses.

Location	Elemental Ca ($mg \cdot l^{-1}$)	Elemental Sr ($mg\ l^{-1}$)	Sr/Ca ratio[b]
Redfish Lake	3.88 (6)	< 0.010 (6)	< 0.0012
Alturas Lake	8.29 (6)	0.110 (6)	0.0061
Wenatchee Lake	2.00 (1)	0.015 (1)	0.0034
Takla Lake			
Eagle Island Hatchery	32.00 (2)	0.340 (2)	0.0049

[a] Detection limits were 0.010 $mg \cdot l^{-1}$

[b] The Sr/Ca ratio is the atomic ratio rather than the ratio of elemental weights.

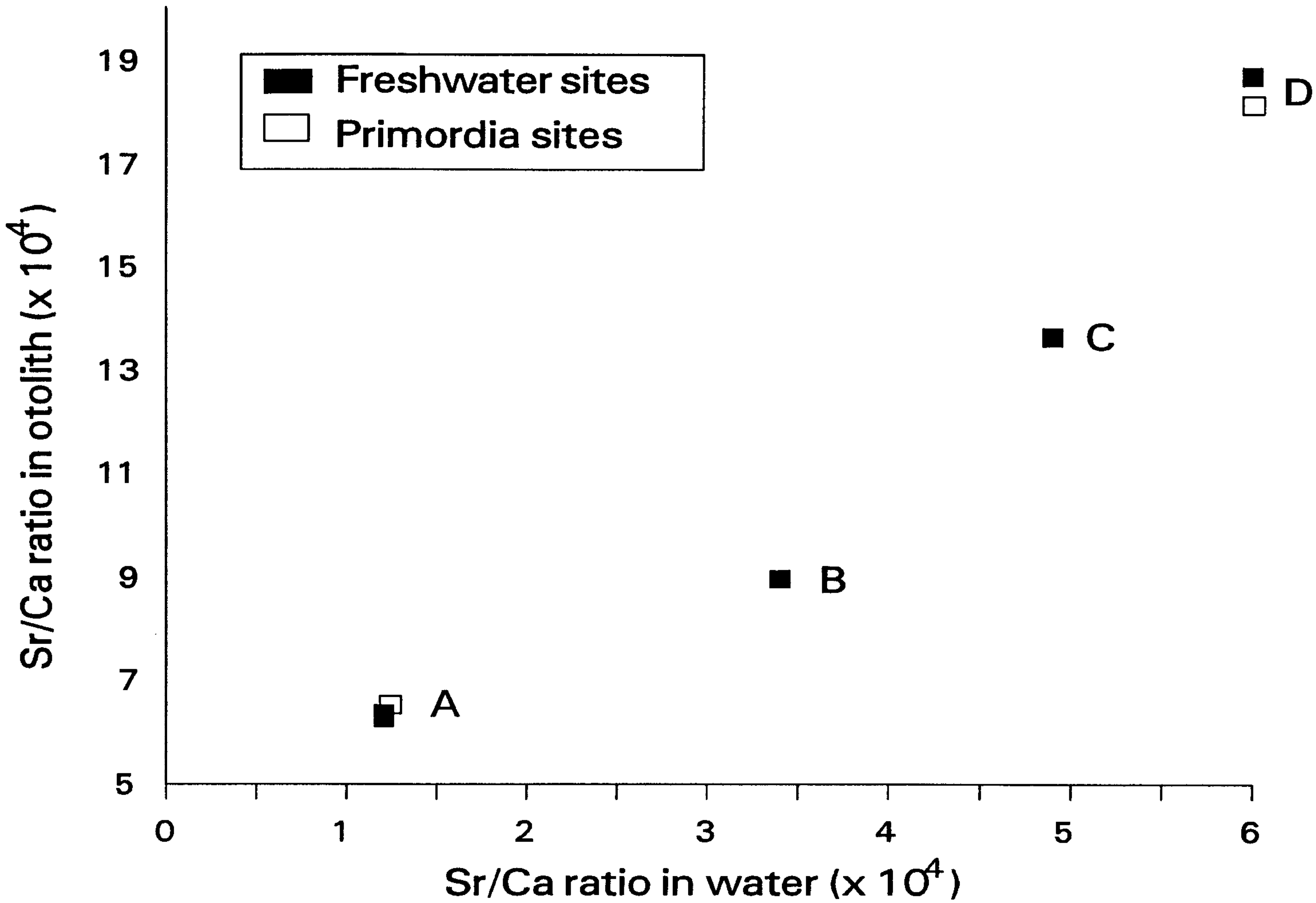

Figure 11. Relation of mean elemental ratios of Sr/Ca in otoliths to ratios in the water of the rearing site. A represents Redfish Lake resident individuals; B represents all Wenatchee Lake individuals; C represents individuals that were held at the Eagle Island Hatchery; and D repesents Alturas Lake resident individuals. Primordia sites were included only when all fish within the sample were of known resident origin.

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of wild *O. nerka* relative to the captive (seafarm or hatchery) stocks represented in Kalish's samples. The anadromous fish in our samples all moved into freshwater well before spawning (2 to 4 months) and undoubtedly experienced a variety of stresses related to the adaptation from saltwater to freshwater and to extended migrations (up to 900 km). It also is not clear to us whether yolkdevelopment is complete when the sockeye salmon represented in our samples leave the ocean. Regardless, some ion exchange can occur between the female and the egg in the period just prior to spawning (Alderdice 1988) that might continue to influence the yolk content and might explain the differences we observed.

Clearly the variation in freshwater chemistry can also have an important influence on the Sr content observed in otoliths derived from resident parents. We observed a substantially elevated Sr/Ca ratio in water samples from Alturas Lake relative to other lakes. The difference in water chemistry was associated with a similar difference in the otoliths. Differences in Sr/Ca ratios among freshwater environments could easily explain differences observed in resident origin primordia between our study and that of Kalish (1990).

Despite our ability to discriminate *O. nerka* of known origin the variation in Sr content in both our known and unknown samples demonstrates some important limitations to discrimination in unknown stocks. Variation in chemistry among lakes could seriously confound some results. The high Sr/Ca ratios in Alturas Lake kokanee salmon otoliths were similar to those from fish of anadromous origin in other lakes. If anadromous fish were present in Alturas lake it would probably be impossible to distinguish their progeny from those of resident fish.

Differences in Sr/Ca composition between nucleus and post hatch locations for fish held at the Eagle Island hatchery (Figures 3C and 6), also indicate that the local environment can strongly influence otolith composition before yolk absorption. Although limited or no ion exchange occurs between the developing embryo and the local environment between water hardening and hatch (Behrens Yamada and Mulligan 1987; Alderdice 1988), exchange may increase dramatically at the point of hatch. The elevated Sr/Ca ratios in posthatch locations in our otoliths were associated with high ratios in the hatchery water supply. Behrens Yamada and Mulligan (1990) found that a Sr mark could be induced in nonfeeding fry by adding relatively large concentrations of Sr to the water supply. Our results strongly suggest that in nonfeeding fry the natural variation in levels of Sr in the environment will produce variation in otolith composition. Otolith microchemistry for discrimination of parental origin must be limited to locations in the primordia which develop prior to hatch. Samples outside that area could be seriously biased by local water chemistry.

Our attempt to characterize the origin of the fish leaving Redfish Lake was also equivocal. The samples produced a range and two modes in Sr/Ca ratios indicating that migrants of both resident and anadromous origin were present. The sample distributions, however, did not break into two clearly discrete groups. A much larger proportion of the samples fell into the range of Sr/Ca from 0.0008-0.0014 than we would have anticipated from the analysis of our known samples. None of the known resident and only one of 15 known anadromous origin samples, but about one third of the 94 unknown samples, fell into that range.

There are two possible reasons for the lack of resolution:

First, the increased variability in the known samples could have been due to analytical error. The variability among sample sites within an otolith tended to be higher in the samples that fell in the range of intermediate Sr/Ca ratios. As a precaution we reexamined the otolith preparations and sample sites for each sample that fell in the intermediate range. We found no evidence that poor sample preparation or a site selection outside of a primordia or in a surface flaw could have contributed to any unusual variation.

Second, our sample size of "knowns" was relatively small and we may not have documented the full variability inherent in otolith chemistry of the wild populations. Our known resident sample included 11 fish that were incubated at the IDFG Eagle Island hatchery plus 10 fish of assumed origin taken from Fishhook Creek. All resident fish in our group of "knowns" were from the Fishhook Creek stock. We recently observed a second group of resident or residual fish spawning on the lake shore. Our anadromous sample included 15 fish but represented only a single female parent. In addition, our known samples were incubated in a relatively stable hatchery environment. Each individual experienced essentially identical conditions of water temperature and chemistry. Embryos from wild fish incubate in a range of conditions that are found in both Fishhook Creek and along the lake shore. Differences in the chemistry of the incubation microhabitats caused by ground water or local tributary influences could contribute to additional variability in the unknown samples (J. Kalish, Ministry of Agriculture and Fisheries, Wellington, NZ. personal communications). Some studies have suggested that Sr/Ca ratio in the otoliths can be related to temperature (Radtke et al. 1990; review in Toole and Nielsen 1992) or rate-of-growth (Kalish 1989; Sadovy and Severin 1992). Temperature during incubation is also known to influence the growth and number of otolith primordia that develop in other salmonids (Nielson et al. 1985) and might well influence the physiology of Ca deposition. Temperatures among and within the spawning habitats in Redfish Lake may vary by 10°C and could have influenced variation in otolith chemistry.

Larger samples of known or safely assumed origin will be important to resolve the expected variability in each group for Redfish Lake and probably for other populations as well. Experimentation with spawning and incubation environments, and examination of the inherent differences in Sr/Ca incorporation between stocks also will be important for further application of microchemistry to problems of parental origin.

Additional information on other genetic and phenotypic characteristics of individual outmigrants might also help with discrimination of origin. Preliminary electrophoretic data suggest that Fishhook Creek kokanee salmon are genetically distinct from the outmigrants as a whole and from the anadromous adults (Waples, 1992). Although the electrophoretic data do not allow classification of individual fish by stock, new DNA analyses might. Genetic comparison of fish that can be clearly characterized as of resident or anadromous origin (eg. Sr/Ca below 0.0008 or above 0.0014) might identify a marker that can be used to characterize all fish. Identification of a genetic marker that can be used to discriminate anadromous and resident progeny would be especially useful in the selection of matings for the captive broodstock.

Our data suggest that size at migration could provide additional information for discrimination of fish by origin. Length of migrants was correlated with the Sr/Ca ratio. Fish with the highest ratios were among the largest fish in the sample. Outmigrants of anadromous origin could be expected to be larger than fish of resident origin. The larger anadromous females produce larger eggs, and resulting alevins (Wood and Foote 1990). Juvenile sockeye salmon may also exhibit better swimming performance than kokanee salmon (Taylor and Foote 1991) that could lead to better growth. The resulting juveniles from anadromous parents could gain an advantage in size over resident fish of the same age that is maintained through the time of migration. With no other information available, size at migration may provide the best method for classifying origin in the captive broodstock. In our sample, 64% of the fish larger than 99 mm were probably of anadromous origin (Sr/Ca > 0.0014), while only 26% of the fish less than 99 mm were probably of anadromous origin.

The number of otolith primordia or size of the nucleus, and number of fin rays or vertebrae have also been related to differences in incubation environments (Nielsen et al. 1985; Claytor and Verspoor 1991). Such phenotypic characters might be used to provide additional resolution of stocks contributing to the outmigration in the future.

At this point, we cannot conclude that resident origin fish are successfully producing anadromous adults in Redfish Lake. The chemistries of all four anadromous adults that returned to Redfish Lake in 1991 were consistent with an anadromous origin. Our data did indicate that both resident and anadromous fish were present among the 1991 outmigrants. The correlation of Sr/Ca ratio to length-of-fish at time of outmigration supports such a conclusion. Fish with the highest ratios were among the largest fish in the sample. Outmigrants of anadromous origin would be expected to be larger than fish of resident origin. The larger anadromous females should produce larger eggs and resulting alevins (Wood and Foote 1990). Juvenile sockeye salmon may also exhibit better swimming performance than kokanee salmon (Taylor and Foote 1991) that could lead to better growth. The resulting juveniles from anadromous parents could gain an advantage in size over resident fish of the same age and maintain that advantage through the time of migration. The data show that resident fish could have contributed a large, if not dominant, proportion of fish leaving the lake in 1991 and that an important component of anadromous behavior has been retained in the resident stock. Further work on these questions is relevant and may well be important to restoration of anadromous Snake River sockeye salmon.

We conclude that otolith microchemistry has the potential to discriminate sympatric resident and anadromous forms of *O. nerka* in some systems and that such questions are important to the understanding and management of the species. Further work is necessary, however, to resolve the level of variation inherent among populations, habitats, and individuals of known origin. Knowledge of local water chemistry and a careful demonstration of differences among known origin fish will be critical to any application in other systems.

The existing information may be useful in discrimination of origin of the captive broodstock. Presently, anadromous origin fish are thought to hold the best chances for successful migration to and from the ocean (see Wood and Foote 1990; Foote et al. 1992; and Taylor and Foote 1991). Broodstock crosses involving both anadromous parents would be the priority if origin could be determined prior to spawning. Evaluation of known origin fish would also be important to determine the relative importance of different life history strategies to recovery. Length at outmigration appeared to be related to Sr/Ca ratio. Because length was recorded for most of the 91 outmigrant snow in the current broodstock, segregation by PIT tag code should be possible before spawning. Because our analyses suggest that about one-third of the outmigrants would be classified as of anadromous origin (and 1/3 unknown, 1/3 resident) random mating should result in about 10% of the families that can be clearly classified as purely anadromous. If only fish larger than 99 mm at outmigration were paired, the results should be about 37% of the families classified as purely anadromous. Without any other information to discriminate origin of individuals in the broodstock, length at outmigration will be the best means of segregating broodstock.

Further research should include: 1) Increased efforts to identify/locate additional spawning populations of resident fish; 2) Clarify genetic and phenotypic differences among the known Fishhook Creek kokanee salmon population, resident origin fish migrating out of the lake, anadromous origin fish migrating out of the lake and anadromous adults; 3) Evaluation of origin for any anadromous adults; in the case of returns to the Sawtooth weir, fish could either have originated from Alturas Lake or Redfish Lake, microchemistry in freshwater growth locations of the otoliths should allow discrimination of those two possibilities; 4) Evaluate the magnitude and variation in outmigration relative to dynamics of the resident populations; 5) Evaluate the relative survival of outmigrants and relate that to variation in characteristics of individuals.

Management should look carefully at measures to ensure stability of the resident populations.

The apparent sensitivity of our results to the variation in freshwater chemistry suggests that otolith microchemistry could have other important applications in stock discrimination. Other work has shown that rare earth elements can be useful as natural markers of individual stocks (Lapi and Mulligan 1981). Doping of hatchery water supplies has also been used to induce marks (Snyder et al. 1992.; Behrens Yamada and Mulligan 1987, 1990; S. Shroeder, Washington Department of Fisheries, Olympia Washington, personal communications). Previous analytical techniques, however, provided limited resolution and sensitivity. Lapi and Mulligan (1981) used energy dispersive microprobe analysis of scales but could not make a quantitative analyses of the individual elements occurring naturally in their samples. Behrens Yamada and Mulligan (1987, 1990) used X-ray fluorescent spectroscopy that required whole body or whole tissue samples for analysis. Snyder et al. (1992) used inductively coupled plasma mass spectroscopy to analyze dried scale samples. The level of an element in whole tissues at the time of marking (or rearing in the natal environment defining the stock) can be diluted by later growth in chemically different environments. For that reason whole tissue analyses require relative large concentrations of the marking element, or isolation (removal) of early growth regions (Behrens Yamada and Mulligan 1982, 1990). Because the wavelength dispersive microprobe can sample very small areas (5 to 10 $_{p}$ diameter) without isolation from surrounding tissue, growth dilution is not a problem. Snyder et al. (1992), Behrens Yamada and Mulligan (1990) and Behrens Yamada et al. (1987) found Sr concentrations from about 1 $mg \cdot l^{-1}$ to 1.8 $mg \cdot l^{-1}$ induced marks in their samples compared to naturally occurring levels of about 10 to 100 $\mu g \cdot l^{-1}$ of Sr that produced significant differences in our samples. Further analyses of naturally occurring variation in water chemistry and otolith composition using wave length dispersive microprobe techniques could prove useful to stock discrimination and mixed stock management problems.

ACKNOWLEDGMENTS

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APPENDICES

Appendix A.

Mean Sr/Ca ratios, total length at, and time of migration for 94 *O. nerka* that migrated out of Redfish Lake in May 1991.

Appendix A.

Fish ID	Fork length	Mean PR Sr/Ca	Mean FW Sr/Ca	Julian date	Fish ID	Fork lengt	Mean PR Sr/Ca	Mean FW Sr/Ca	Julia date
ERE91-02		0.00096	0.00094		ERE91-62	94	0.00152	0.00154	140
ERE91-03	101	0.00153	0.00058	138	ERE91-63		0.00085	0.00124	
ERE91-04/05		0.00192	0.00082	144	ERE91-65		0.00057	0.00144	
ERE91-04/05		0.00034	0.00042	144	ERE91-66		0.00198	0.00132	
ERE91-06	97	0.00137	0.00084	145	RE91-03		0.00088	0.00075	130
ERE91-08	108	0.00172	0.00061	138	RE91-04		0.00099	0.00056	130
ERE91-09	80	0.00184	0.00154	158	RE91-05		0.00087	0.00060	130
ERE91-11	94	0.00055	0.00060	142	RE91-06		0.00062	0.00051	130
ERE91-12	89	0.00058	0.00068	144	RE91-08		0.00062	0.00058	130
ERE91-13	90	0.00113	0.00067	144	RE91-09		0.00077	0.00066	130
ERE91-14	99	0.00104	0.00129	143	RE91-10		0.00132	0.00069	130
ERE91-15	107	0.00195	0.00129	144	RE91-12		0.00078	0.00055	130
ERE91-16	95	0.00130	0.00028	141	RE91-13		0.00061	0.00064	130
ERE91-17	111	0.00065	0.00151	143	RE91-15		0.00072	0.00076	131
ERE91-21	106	0.00179	0.00142	143	RE91-16		0.00107	0.00049	131
ERE91-22	94	0.00079	0.00064	134	RE91-18		0.00114	0.00067	131
ERE91-23	102	0.00061	0.00059	142	RE91-19		0.00083	0.00063	131
ERE91-24	90	0.00102	0.00125	128	RE91-20		0.00126	0.00066	131
ERE91-25	105	0.00190	0.00058	138	RE91-22		0.00061	0.00063	140
ERE91-26		0.00087	0.00154		RE91-23	100	0.00059	0.00063	143
ERE91-27	105	0.00185	0.00146	141	RE91-24	100	0.00228	0.00057	143
ERE91-28	103	0.00206	0.00134	143	RE91-25	90	0.00064	0.00063	143
ERE91-29	104	0.00211		144	RE91-26	90	0.00098	0.00064	143
ERE91-31	96	0.00127	0.00146	138	RE91-27	100	0.00079	0.00059	143
ERE91-33	94	0.00138	0.00139	137	RE91-28		0.00117	0.00069	
ERE91-34	105	0.00227		131	RE91-30	90	0.00062	0.00058	143
ERE91-36	103	0.00108	0.00130	140	RE91-31	87	0.00058	0.00058	143
ERE91-37	112	0.00190	0.00123	139	RE91-32	83	0.00054	0.00058	144
ERE91-39	102	0.00114	0.00144	143	RE91-33	108	0.00176	0.00058	143
ERE91-41	99	0.00216	0.00119	131	RE91-36	104	0.00104	0.00063	143
ERE91-43	96	0.00142	0.00154	141	RE91-38	88	0.00056	0.00073	145
ERE91-44	99	0.00083	0.00058	139	RE91-41	108	0.00171	0.00058	145
ERE91-45	101	0.00131	0.00139	141	RE91-42	90	0.00099	0.00058	145
ERE91-47	94	0.00158	0.00170	138	RE91-43	91	0.00068	0.00065	145
ERE91-48		0.00213	0.00140		RE91-44	102	0.00172	0.00061	145
ERE91-49		0.00103	0.00170		RE91-45		0.00063	0.00060	
ERE91-50	96	0.00058	0.00159	147	RE91-46	105	0.00195	0.00061	145
ERE91-51	98	0.00097	0.00132	138	RE91-48	85	0.00093	0.00069	145
ERE91-52	89	0.00150	0.00159	140	RE91-50	91	0.00084	0.00067	146
ERE91-53	88	0.00058	0.00063	139	RE91-51	88	0.00107	0.00053	147
ERE91-54	102	0.00214	0.00141	140	RE91-52	91	0.00051	0.00056	148
ERE91-55	97	0.00125	0.00127	140	RE91-53	94	0.00081	0.00061	148
ERE91-56	92	0.00056	0.00161	140	RE91-54	96	0.00063	0.00057	148
ERE91-58	107	0.00186	0.00131	138	RE91-55	86	0.00072	0.00076	149
ERE91-59	93	0.00065	0.00166	138	RE91-56	109	0.00073	0.00069	149
ERE91-60	90	0.00053	0.00067	138	RE91-57	96	0.00073	0.00053	147
ERE91-61	103	0.00224	0.00133	139	RE91-58	114	0.00067	0.00067	155

Appendix B.

Microchemistry results for all sample sites on otoliths from 94 _O. nerka_ that migrated out of Redfish Lake in May 1991.

Appendix B.

FISH ID	SAMPLE SITE	SR LEVEL	CA LEVEL	SRCA RATIO	FISH ID	SAMPLE SITE	SR LEVEL	CA LEVEL	SRCA RATIO
ERE91-02	PR	0.0022	1.9965	0.00110	ERE91-05	PR	0.0038	1.9925	0.00191
ERE91-02	PR	0.0021	1.9967	0.00105	ERE91-05	PR	0.0034	1.9916	0.00171
ERE91-02	PR	0.0020	1.9956	0.00100	ERE91-05	FW	0.0017	1.9982	0.00085
ERE91-02	PR	0.0019	1.9968	0.00095	ERE91-05	FW	0.0017	1.9978	0.00085
ERE91-02	PR	0.0017	1.9952	0.00085	ERE91-05	FW	0.0016	1.9976	0.00080
ERE91-02	PR	0.0016	1.9964	0.00080	ERE91-05	FW	0.0015	1.9981	0.00075
ERE91-02	FW	0.0021	1.9970	0.00105	ERE91-05	FW	0.0017	1.9975	0.00085
ERE91-02	FW	0.0020	1.9969	0.00100	ERE91-06	FW	0.0017	1.9971	0.00085
ERE91-02	FW	0.0019	1.9973	0.00095	ERE91-06	PR	0.0029	1.9954	0.00145
ERE91-02	FW	0.0018	1.9979	0.00090	ERE91-06	FW	0.0015	1.9977	0.00075
ERE91-02	FW	0.0018	1.9974	0.00090	ERE91-06	PR	0.0031	1.9952	0.00155
ERE91-02	FW	0.0017	1.9977	0.00085	ERE91-06	FW	0.0018	1.9969	0.00090
ERE91-04	PR	0.0012	1.9981	0.00060	ERE91-06	PR	0.0030	1.9950	0.00150
ERE91-04	PR	0.0009	1.9971	0.00045	ERE91-06	FW	0.0014	1.9973	0.00070
ERE91-04	PR	0.0008	1.9973	0.00040	ERE91-06	PR	0.0021	1.9956	0.00105
ERE91-04	PR	0.0007	1.9969	0.00035	ERE91-06	PR	0.0033	1.9952	0.00165
ERE91-04	PR	0.0004	1.9981	0.00020	ERE91-06	FW	0.0019	1.9969	0.00095
ERE91-04	PR	0.0001	1.9966	0.00005	ERE91-06	FW	0.0018	1.9973	0.00090
ERE91-04	FW	0.0011	1.9989	0.00055	ERE91-08	FW	0.0013	1.9984	0.00065
ERE91-04	FW	0.0010	1.9989	0.00050	ERE91-08	FW	0.0016	1.9984	0.00080
ERE91-04	FW	0.0008	1.9990	0.00040	ERE91-08	FW	0.0018	1.9982	0.00090
ERE91-04	FW	0.0007	1.9993	0.00035	ERE91-08	PR	0.0030	1.9965	0.00150
ERE91-04	FW	0.0007	1.9992	0.00035	ERE91-08	PR	0.0032	1.9965	0.00160
ERE91-04	FW	0.0007	1.9992	0.00035	ERE91-08	PR	0.0036	1.9963	0.00180
ERE91-05	PR	0.0046	1.9932	0.00231	ERE91-08	PR	0.0037	1.9959	0.00185
ERE91-05	PR	0.0038	1.9930	0.00191	ERE91-08	PR	0.0037	1.9961	0.00185
ERE91-05	FW	0.0016	1.9981	0.00080	ERE91-08	FW	0.0007	1.9993	0.00035
ERE91-05	PR	0.0037	1.9930	0.00186	ERE91-08	FW	0.0008	1.9991	0.00040
ERE91-05	PR	0.0037	1.9921	0.00186	ERE91-08	FW	0.0011	1.9989	0.00055

Appendix B. (continued)

FISH ID	SAMPLE SITE	SR LEVEL	CA LEVEL	SRCA RATIO
ERE91-09	FW	0.0031	1.9940	0.00155
ERE91-09	FW	0.0032	1.9943	0.00160
ERE91-09	FW	0.0032	1.9942	0.00160
ERE91-09	FW	0.0032	1.9944	0.00160
ERE91-09	FW	0.0028	1.9942	0.00140
ERE91-09	PR	0.0033	1.9914	0.00166
ERE91-09	PR	0.0033	1.9922	0.00166
ERE91-09	PR	0.0035	1.9911	0.00176
ERE91-09	FW	0.0029	1.9950	0.00145
ERE91-09	PR	0.0041	1.9909	0.00206
ERE91-09	PR	0.0038	1.9902	0.00191
ERE91-09	PR	0.0040	1.9916	0.00201
ERE91-11	FW	0.0010	1.9990	0.00050
ERE91-11	FW	0.0011	1.9989	0.00055
ERE91-11	FW	0.0012	1.9985	0.00060
ERE91-11	FW	0.0012	1.9988	0.00060
ERE91-11	FW	0.0013	1.9986	0.00065
ERE91-11	FW	0.0014	1.9985	0.00070
ERE91-11	PR	0.0008	1.9962	0.00040
ERE91-11	PR	0.0009	1.9976	0.00045
ERE91-11	PR	0.0011	1.9985	0.00055
ERE91-11	PR	0.0012	1.9977	0.00060
ERE91-11	PR	0.0013	1.9972	0.00065
ERE91-11	PR	0.0013	1.9977	0.00065
ERE91-12	FW	0.0013	1.9987	0.00065
ERE91-12	FW	0.0015	1.9978	0.00075
ERE91-12	FW	0.0013	1.9986	0.00065
ERE91-12	FW	0.0019	1.9978	0.00095
ERE91-12	FW	0.0010	1.9988	0.00050

FISH ID	SAMPLE SITE	SR LEVEL	CA LEVEL	SRCA RATIO
ERE91-12	FW	0.0011	1.9983	0.00055
ERE91-12	PR	0.0012	1.9979	0.00060
ERE91-12	PR	0.0012	1.9979	0.00060
ERE91-12	PR	0.0012	1.9981	0.00060
ERE91-12	PR	0.0010	1.9962	0.00050
ERE91-12	PR	0.0013	1.9961	0.00065
ERE91-12	PR	0.0011	1.9987	0.00055
ERE91-13	FW	0.0017	1.9975	0.00085
ERE91-13	FW	0.0016	1.9973	0.00080
ERE91-13	FW	0.0013	1.9974	0.00065
ERE91-13	FW	0.0010	1.9981	0.00050
ERE91-13	FW	0.0010	1.9976	0.00050
ERE91-13	FW	0.0014	1.9984	0.00070
ERE91-13	PR	0.0016	1.9975	0.00080
ERE91-13	PR	0.0016	1.9962	0.00080
ERE91-13	PR	0.0027	1.9960	0.00135
ERE91-13	PR	0.0027	1.9959	0.00135
ERE91-13	PR	0.0027	1.9962	0.00135
ERE91-14	PR	0.0025	1.9971	0.00125
ERE91-14	PR	0.0022	1.9972	0.00110
ERE91-14	PR	0.0020	1.9980	0.00100
ERE91-14	PR	0.0015	1.9985	0.00075
ERE91-14	PR	0.0022	1.9978	0.00110
ERE91-14	PR	0.0021	1.9979	0.00105
ERE91-14	FW	0.0030	1.9970	0.00150
ERE91-14	FW	0.0026	1.9971	0.00130
ERE91-14	FW	0.0027	1.9973	0.00135
ERE91-14	FW	0.0026	1.9973	0.00130
ERE91-14	FW	0.0025	1.9973	0.00125

Appendix B. (continued)

FISH ID	SAMPLE SITE	SR LEVEL	CA LEVEL	SRCA RATIO
ERE91-14	FW	0.0020	1.9980	0.00100
ERE91-15	PR	0.0040	1.9937	0.00201
ERE91-15	PR	0.0038	1.9941	0.00191
ERE91-15	PR	0.0037	1.9930	0.00186
ERE91-15	PR	0.0038	1.9934	0.00191
ERE91-15	PR	0.0040	1.9934	0.00201
ERE91-15	PR	0.0040	1.9933	0.00201
ERE91-15	FW	0.0024	1.9952	0.00120
ERE91-15	FW	0.0023	1.9960	0.00115
ERE91-15	FW	0.0030	1.9948	0.00150
ERE91-15	FW	0.0026	1.9960	0.00130
ERE91-15	FW	0.0026	1.9962	0.00130
ERE91-15	FW	0.0025	1.9959	0.00125
ERE91-16	FW	0.0003	1.9948	0.00015
ERE91-16	FW	0.0003	1.9955	0.00015
ERE91-16	FW	0.0005	1.9951	0.00025
ERE91-16	FW	0.0007	1.9944	0.00035
ERE91-16	FW	0.0007	1.9956	0.00035
ERE91-16	FW	0.0008	1.9950	0.00040
ERE91-16	PR	0.0023	1.9977	0.00115
ERE91-16	PR	0.0023	1.9977	0.00115
ERE91-16	PR	0.0026	1.9973	0.00130
ERE91-16	PR	0.0027	1.9971	0.00135
ERE91-16	PR	0.0028	1.9971	0.00140
ERE91-16	PR	0.0029	1.9971	0.00145
ERE91-16BP	FW	0.0015	1.9923	0.00075
ERE91-16BP	PR	0.0031	1.9907	0.00156
ERE91-16BP	PR	0.0030	1.9959	0.00150
ERE91-16BP	PR	0.0034	1.9893	0.00171

FISH ID	SAMPLE SITE	SR LEVEL	CA LEVEL	SRCA RATIO
ERE91-16BP	PR	0.0023	1.9915	0.00115
ERE91-16BP	PR	0.0031	1.9909	0.00156
ERE91-16BP	PR	0.0022	1.9894	0.00111
ERE91-16BP	FW	0.0015	1.9927	0.00075
ERE91-16BP	FW	0.0010	1.9924	0.00050
ERE91-16BP	FW	0.0010	1.9929	0.00050
ERE91-16BP	FW	0.0014	1.9934	0.00070
ERE91-16BP	FW	0.0010	1.9931	0.00050
ERE91-17	PR	0.0017	1.9955	0.00085
ERE91-17	PR	0.0014	1.9950	0.00070
ERE91-17	FW	0.0032	1.9954	0.00160
ERE91-17	PR	0.0012	1.9962	0.00060
ERE91-17	PR	0.0014	1.9972	0.00070
ERE91-17	PR	0.0008	1.9963	0.00040
ERE91-17	FW	0.0030	1.9952	0.00150
ERE91-17	FW	0.0032	1.9955	0.00160
ERE91-17	FW	0.0028	1.9957	0.00140
ERE91-17	FW	0.0030	1.9959	0.00150
ERE91-17	FW	0.0029	1.9956	0.00145
ERE91-17	PR	0.0013	1.9955	0.00065
ERE91-21	FW	0.0028	1.9938	0.00140
ERE91-21	FW	0.0030	1.9943	0.00150
ERE91-21	PR	0.0043	1.9924	0.00216
ERE91-21	FW	0.0028	1.9937	0.00140
ERE91-21	FW	0.0030	1.9938	0.00150
ERE91-21	FW	0.0027	1.9939	0.00135
ERE91-21	PR	0.0036	1.9932	0.00181
ERE91-21	PR	0.0029	1.9938	0.00145
ERE91-21	PR	0.0032	1.9933	0.00161

Appendix B. (continued)

FISH ID	SAMPLE SITE	SR LEVEL	CA LEVEL	SRCA RATIO
ERE91-21	PR	0.0039	1.9924	0.00196
ERE91-21	PR	0.0035	1.9926	0.00176
ERE91-21	FW	0.0027	1.9939	0.00135
ERE91-22	FW	0.0013	1.9975	0.00065
ERE91-22	F W	0.0012	1.9972	0.00060
ERE91-22	FW	0.0011	1.9978	0.00055
ERE91-22	FW	0.0014	1.9975	0.00070
ERE91-22	PR	0.0014	1.9948	0.00070
ERE91-22	FW	0.0015	1.9975	0.00075
ERE91-22	PR	0.0016	1.9953	0.00080
ERE91-22	PR	0.0014	1.9963	0.00070
ERE91-22	PR	0.0015	1.9960	0.00075
ERE91-22	FW	0.0012	1.9976	0.00060
ERE91-22	PR	0.0018	1.9928	0.00090
ERE91-22	PR	0.0018	1.9961	0.00090
ERE91-23	FW	0.0012	1.9985	0.00060
ERE91-23	FW	0.0010	1.9989	0.00050
ERE91-23	FW	0.0011	1.9986	0.00055
ERE91-23	FW	0.0013	1.9981	0.00065
ERE91-23	FW	0.0013	1.9986	0.00065
ERE91-23	PR	0.0008	1.9985	0.00040
ERE91-23	PR	0.0014	1.9957	0.00070
ERE91-23	PR	0.0010	1.9983	0.00050
ERE91-23	PR	0.0011	1.9958	0.00055
ERE91-23	FW	0.0012	1.9978	0.00060
ERE91-23	PR	0.0015	1.9976	0.00075
ERE91-23	PR	0.0015	1.9984	0.00075
ERE91-24	FW	0.0024	1.9976	0.00120
ERE91-24	FW	0.0024	1.9976	0.00120

FISH ID	SAMPLE SITE	SR LEVEL	CA LEVEL	SRCA RATIO
ERE91-24	FW	0.0028	1.9972	0.00140
ERE91-24	FW	0.0023	1.9976	0.00115
ERE91-24	FW	0.0023	1.9974	0.00115
ERE91-24	FW	0.0028	1.9972	0.00140
ERE91-24	PR	0.0021	1.9975	0.00105
ERE91-24	PR	0.0019	1.9974	0.00095
ERE91-24	PR	0.0020	1.9973	0.00100
ERE91-24	PR	0.0020	1.9973	0.00100
ERE91 -24	PR	0.0023	1.9973	0.00115
ERE91-24	PR	0.0019	1.9978	0.00095
ERE91-25	PR	0.0037	1.9943	0.00186
ERE91-25	PR	0.0035	1.9946	0.00175
ERE91-25	FW	0.0010	1.9989	0.00050
ERE91-25	PR	0.0033	1.9946	0.00165
ERE91-25	FW	0.0015	1.9985	0.00075
ERE91-25	PR	0.0035	1.9943	0.00176
ERE91-25	FW	0.0011	1.9989	0.00055
ERE91-25	PR	0.0042	1.9956	0.00210
ERE91-25	PR	0.0045	1.9943	0.00226
ERE91-25	FW	0.0009	1.9991	0.00045
ERE91-25	FW	0.0011	1.9986	0.00055
ERE91-25	FW	0.0013	1.9985	0.00065
ERE91-26	PR	0.0020	1.9980	0.00100
ERE91-26	PR	0.0015	1.9980	0.00075
ERE91-26	PR	0.0023	1.9974	0.00115
ERE91-26	FW	0.0031	1.9968	0.00155
ERE91-26	FW	0.0030	1.9970	0.00150
ERE91-26	PR	0.0016	1.9984	0.00080
ERE91-26	FW	0.0029	1.9971	0.00145

Appendix B. (continued)

FISH ID	SAMPLE SITE	SR LEVEL	CA LEVEL	SRCA RATIO	FISH ID	SAMPLE SITE	SR LEVEL	CA LEVEL	SRCA RATIO
ERE91-26	PR	0.0016	1.9979	0.00080	ERE91-29	PR	0.0036	1.9941	0.00181
ERE91-26	FW	0.0030	1.9970	0.00150	ERE91-29	PR	0.0039	1.9916	0.00196
ERE91-26	PR	0.0014	1.9976	0.00070	ERE91-29	PR	0.0041	1.9936	0.00206
ERE91-26	FW	0.0034	1.9965	0.00170	ERE91-29	PR	0.0041	1.9939	0.00206
ERE91-26	FW	0.0030	1.9970	0.00150	ERE91-29	PR	0.0047	1.9943	0.00236
ERE91-27	FW	0.0030	1.9967	0.00150	ERE91-29	PR	0.0048	1.9940	0.00241
ERE91-27	FW	0.0025	1.9968	0.00125	ERE91-30	FW	0.0010	1.9977	0.00050
ERE91-27	FW	0.0026	1.9972	0.00130	ERE91-30	FW	0.0010	1.9981	0.00050
ERE91-27	PR	0.0039	1.9950	0.00195	ERE91-30	FW	0.0012	1.9980	0.00060
ERE91-27	PR	0.0037	1.9959	0.00185	ERE91-30	FW	0.0013	1.9971	0.00065
ERE91-27	PR	0.0040	1.9957	0.00200	ERE91-30	FW	0.0014	1.9972	0.00070
ERE91-27	FW	0.0027	1.9973	0.00135	ERE91-30	PR	0.0031	1.9954	0.00155
ERE91-27	FW	0.0033	1.9965	0.00165	ERE91-30	PR	0.0029	1.9963	0.00145
ERE91-27	FW	0.0034	1.9965	0.00170	ERE91-30	FW	0.0010	1.9975	0.00050
ERE91-27	PR	0.0033	1.9963	0.00165	ERE91-30	PR	0.0029	1.9960	0.00145
ERE91-27	PR	0.0037	1.9963	0.00185	ERE91-30	PR	0.0034	1.9954	0.00170
ERE91-27	PR	0.0036	1.9959	0.00180	ERE91-30	PR	0.0030	1.9961	0.00150
ERE91-28	PR	0.0039	1.9956	0.00195	ERE91-31	PR	0.0026	1.9937	0.00130
ERE91-28	PR	0.0033	1.9962	0.00165	ERE91-31	FW	0.0030	1.9937	0.00150
ERE91-28	PR	0.0034	1.9954	0.00170	ERE91-31	FW	0.0029	1.9936	0.00145
ERE91-28	FW	0.0030	1.9968	0.00150	ERE91-31	PR	0.0024	1.9935	0.00120
ERE91-28	FW	0.0024	1.9971	0.00120	ERE91-31	PR	0.0025	1.9950	0.00125
ERE91-28	FW	0.0028	1.9972	0.00140	ERE91-31	PR	0.0028	1.9934	0.00140
ERE91-28	FW	0.0029	1.9971	0.00145	ERE91-31	PR	0.0025	1.9749	0.00127
ERE91-28	FW	0.0023	1.9977	0.00115	ERE91-31	FW	0.0023	1.9943	0.00115
ERE91-28	FW	0.0027	1.9973	0.00135	ERE91-31	FW	0.0028	1.9942	0.00140
ERE91-28	PR	0.0043	1.9957	0.00215	ERE91-31	FW	0.0036	1.9937	0.00181
ERE91-28	PR	0.0052	1.9948	0.00261	ERE91-31	FW	0.0029	1.9940	0.00145
ERE91-28	PR	0.0046	1.9949	0.00231	ERE91-31	PR	0.0024	1.9948	0.00120

Appendix B. (continued)

FISH ID	SAMPLE SITE	SR LEVEL	CA LEVEL	SRCA RATIO	FISH ID	SAMPLE SITE	SR LEVEL	CA LEVEL	SRCA RATIO
ERE91-33	PR	0.0033	1.9950	0.00165	ERE91-34	PR	0.0046	4.9927	0.00092
ERE91-33	PR	0.0030	1.9958	0.00150	ERE91-36	PR	0.0023	1.9970	0.00115
ERE91-33	PR	0.0027	1.9970	0.00135	ERE91-36	PR	0.0019	1.9972	0.00095
ERE91-33	PR	0.0027	1.9969	0.00135	ERE91-36	PR	0.0022	1.9974	0.00110
ERE91-33	PR	0.0027	1.9960	0.00135	ERE91-36	PR	0.0018	1.9969	0.00090
ERE91-33	PR	0.0021	1.9970	0.00105	ERE91-36	PR	0.0022	1.9966	0.00110
ERE91-33	*FW*	0.0036	1.9957	0.00180	ERE91-36	PR	0.0026	1.9972	0.00130
ERE91-33	FW	0.0019	1.9971	0.00095	ERE91-36	FW	0.0028	1.9971	0.00140
ERE91-33	FW	0.0025	1.9968	0.00125	ERE91-36	FW	0.0025	1.9975	0.00125
ERE91-33	FW	0.0028	1.9967	0.00140	ERE91-36	FW	0.0026	1.9972	0.00130
ER E91-33	FW	0.0029	1.9967	0.00145	ERE91-36	FW	0.0025	1.9967	0.00125
ERE91-33	FW	0.0030	1.9964	0.00150	ERE91-36	FW	0.0028	1.9972	0.00140
ERE91-33BP	FW	0.0039	1.9956	0.00195	ERE91-36	FW	0.0024	1.9974	0.00120
ERE9133BP	FW	0.0035	1.9963	0.00175	ERE91-36B	FW	0.0011	1.9940	0.00055
ERE91-33BP	FW	0.0031	1.9962	0.00155	ERE91-36B	FW	0.0011	1.9939	0.00055
ERE91-33BP	PR	0.0026	1.9973	0.00130	ERE91-36B	FW	0.0013	1.9937	0.00065
ERE91-33BP	PR	0.0029	1.9962	0.00145	ERE9136B	FW	0.0015	1.9921	0.00075
ERE91-33BP	PR	0.0027	1.9963	0.00135	ERE9136B	RN	0.0011	1.9937	0.00055
ERE9133BP	FW	0.0038	1.9958	0.00190	ERE91-36B	FW	0.0015	1.9929	0.00075
ERE91-33BP	PR	0.0031	1.9962	0.00155	ERE91-36B	PR	0.0016	1.9921	0.00080
ERE9133BP	PR	0.0023	1.9969	0.00115	ERE91-36B	PR	0.0018	1.9901	0.00090
ERE91-33BP	PR	0.0030	1.9955	0.00150	ERE91-36B	PR	0.0018	1.9890	0.00091
ERE91-33 BP	FW	0.0035	1.9953	0.00175	ERE91-36B	PR	0.0019	1.9897	0.00095
ERE91-33BP	FW	0.0034	1.9962	0.00170	ERE91-36B	PR	0.0020	1.9905	0.00100
ERE91-34	PR	0.0043	1.9896	0.00216	ERE91-36B	PR	0.0018	1.9912	0.00090
ERE91-34	PR	0.0044-	9929	0.00221	ERE91-37	PR	0.0045	1.9955	0.00226
ERE91-34	PR	0.0046	1.9914	0.00231	ERE91-37	PR	0.0038	1.9959	0.00190
ERE91-34	PR	0.0046	1.9920	0.00231	ER E91-37	PR	0.0035	1.9955	0.00175
ERE91-34	PR	0.0046	1.9936	0.00231	ERE91-37	PR	0.0032	1.9966	0.00160

Appendix B. (continued)

FISH ID	SAMPLE SITE	SR LEVEL	CA LEVEL	SRCA RATIO
ERE91-37	PR	0.0032	1.9947	0.00160
ERE91-37	PR	0.0045	1.9955	0.00226
ERE91-37	FW	0.0025	1.9972	0.00125
ERE91-37	FW	0.0022	1.9974	0.00110
ERE91-37	FW	0.0022	1.9974	0.00110
ERE91-37	FW	0.0026	1.9972	0.00130
ERE91-37	FW	0.0024	1.9964	0.00120
ERE91-37	FW	0.0028	1.9968	0.00140
ERE91-39	PR	0.0021	1.9975	0.00105
ERE91-39	PR	0.0025	1.9970	0.00125
ERE91-39	PR	0.0019	1.9955	0.00095
ERE91-39	PR	0.0025	1.9969	0.00125
ERE91-39	PR	0.0026	1.9966	0.00130
ERE91-39	PR	0.0021	1.9979	0.00105
ERE91-39	FW	0.0030	1.9966	0.00150
ERE91-39	FW	0.0029	1.9966	0.00145
ERE91-39	FW	0.0028	1.9972	0.00140
ERE91-39	FW	0.0028	1.9971	0.00140
ERE91-39	FW	0.0030	1.9964	0.00150
ERE91-39	FW	0.0028	1.9972	0.00140
ERE91-41	PR	0.0040	1.9944	0.00201
ERE91-41	PR	0.0045	1.9945	0.00226
ERE91-41	PR	0.0046	1.9943	0.00231
ERE91-41	PR	0.0041	1.9948	0.00206
ERE91-41	PR	0.0044	1.9937	0.00221
ERE91-41	PR	0.0043	1.9938	0.00216
ERE91-41	*RN*	0.0023	1.9962	0.00115
ERE91-41	FW	0.0022	1.9963	0.00110
ERE91-41	FW	0.0028	1.9952	0.00140

FISH ID	SAMPLE SITE	SR LEVEL	CA LEVEL	SRCA RATIO
ERE91-41	FW	0.0027	1.9951	0.00135
ERE91-41	FW	0.0022	1.9966	0.00110
ERE91-41	FW	0.0020	1.9966	0.00100
ERE91-43	PR	0.0029	1.9965	0.00145
ERE91-43	PR	0.0027	1.9967	0.00135
ERE91-43	PR	0.0027	1.9959	0.00135
ERE91-43	PR	0.0029	1.9971	0.00145
ERE91-43	PR	0.0029	1.9960	0.00145
ERE91-43	FW	0.0032	1.9968	0.00160
ERE91-43	FW	0.0031	1.9968	0.00155
ERE91-43	FW	0.0033	1.9961	0.00165
ERE91-43	FW	0.0029	1.9964	0.00145
ERE91-43	PR	0.0029	1.9970	0.00145
ERE91-43	FW	0.0028	1.9967	0.00140
ERE91-43	FW	0.0031	1.9965	0.00155
ERE91-44	FW	0.0012	1.9961	0.00060
ERE91-44	FW	0.0014	1.9966	0.00070
ERE91-44	FW	0.0012	1.9959	0.00060
ERE91-44	PR	0.0017	1.9956	0.00085
ERE91-44	PR	0.0020	1.9955	0.00100
ERE91-44	FW	0.0011	1.9964	0.00055
ERE91-44	PR	0.0018	1.9951	0.00090
ERE91-44	PR	0.0014	1.9956	0.00070
ERE91-44	*RN*	0.0010	1.9960	0.00050
ERE91-44	FW	0.0011	1.9960	0.00055
ERE91-44	PR	0.0014	1.9956	0.00070
ERE91-44	PR	0.0016	1.9949	0.00080
ERE91-45	PR	0.0034	1.9966	0.00170
ERE91-45	PR	0.0022	1.9964	0.00110

Appendix B. (continued)

FISH ID	SAMPLE SITE	SR LEVEL	CA LEVEL	SRCA RATIO	FISH ID	SAMPLE SITE	SR LEVEL	CA LEVEL	SRCA RATIO
ERE91-45	PR	0.0024	1.9964	0.00120	ERE91-48	PR	0.0043	1.9955	0.00215
ERE91-45	PR	0.0028	1.9962	0.00140	ERE91-48	PR	0.0043	1.9957	0.00215
ERE91-45	PR	0.0020	1.9976	0.00100	ERE91-48	FW	0.0028	1.9970	0.00140
ERE91-45	PR	0.0029	1.9970	0.00145	ERE91-48	PR	0.0043	1.9957	0.00215
ERE91-45	FW	0.0030	1.9970	0.00150	ERE91-48	PR	0.0039	1.9960	0.00195
ERE91-45	FW	0.0024	1.9976	0.00120	ERE91-49	PR	0.0027	1.9965	0.00135
ERE91-45	FW	0.0024	1.9976	0.00120	ERE91-49	PR	0.0020	1.9974	0.00100
ERE91-45	FW	0.0029	1.9971	0.00145	ERE91-49	FW	0.0032	1.9962	0.00160
ERE91-45	FW	0.0030	1.9970	0.00150	ERE91-49	PR	0.0015	1.9978	0.00075
ERE91-45	FW	0.0029	1.9971	0.00145	ERE91-49	PR	0.0018	1.9974	0.00090
ERE91-47	PR	0.0034	1.9966	0.00170	ERE91-49	PR	0.0020	1.9976	0.00100
ERE91-47	PR	0.0030	1.9970	0.00150	ERE91-49	PR	0.0024	1.9974	0.00120
ERE91-47	PR	0.0030	1.9969	0.00150	ERE91-49	FW	0.0035	1.9965	0.00175
ERE91-47	PR	0.0031	1.9969	0.00155	ERE91-49	FW	0.0033	1.9965	0.00165
ERE91-47	PR	0.0035	1.9963	0.00175	ERE91-49	FW	0.0032	1.9961	0.00160
ERE91-47	PR	0.0029	1.9971	0.00145	ERE91-49	FW	0.0036	1.9955	0.00180
ERE91-47	FW	0.0039	1.9961	0.00195	ERE91-49	FW	0.0035	1.9959	0.00175
ERE91-47	RN	0.0034	1.9965	0.00170	ERE91-50	FW	0.0033	1.9961	0.00165
ERE91-47	RN	0.0033	1.9967	0.00165	ERE91-50	FW	0.0034	1.9966	0.00170
ERE91-47	RN	0.0038	1.9961	0.00190	ERE91-50	PR	0.0010	1.9987	0.00050
ERE91-47	RN	0.0029	1.9964	0.00145	ERE91-50	PR	0.0012	1.9985	0.00060
ERE91-47	FW	0.0031	1.9963	0.00155	ERE91-50	RN	0.0034	1.9966	0.00170
ERE91-48	FW	0.0027	1.9973	0.00135	ERE91-50	FW	0.0031	1.9967	0.00155
ERE91-48	RN	0.0030	1.9969	0.00150	ERE91-50	PR	0.0016	1.9981	0.00080
ERE91-48	FW	0.0028	1.9969	0.00140	ERE91-50	PR	0.0009	1.9989	0.00045
ERE91-48	FW	0.0027	1.9972	0.00135	ERE91-50	PR	0.0011	1.9989	0.00055
ERE91-48	FW	0.0028	1.9968	0.00140	ERE91-50	PR	0.0011	1.9936	0.00055
ERE91-48	PR	0.0046	1.9954	0.00231	ERE91-50	PR	0.0013	1.9943	0.00065
ERE91-48	PR	0.0041	1.9946	0.00206	ERE91-50	PR	0.0010	1.9989	0.00050

Appendix B. (continued)

FISH ID	SAMPLE SITE	SR LEVEL	CA LEVEL	SRCA RATIO	FISH ID	SAMPLE SITE	SR LEVEL	CA LEVEL	SRCA RATIO
ERE91-50	FW	0.0029	1.9969	0.00145	ERE91-52	FW	0.0034	1.9966	0.00170
ERE91-50	FW	0.0029	1.9971	0.00145	ERE91-52	FW	0.0027	1.9973	0.00135
ERE91-51	PR	0.0018	1.9982	0.00090	ERE91-52	PR	0.0027	1.9968	0.00135
ERE91-51	PR	0.0021	1.9978	0.00105	ERE91-52	PR	0.0031	1.9968	0.00155
ERE91-51	PR	0.0022	1.9967	0.00110	ERE91-52	FW	0.0037	1.9963	0.00185
ERE91-51	PR	0.0017	1.9981	0.00085	ERE91-52	FW	0.0029	1.9971	0.00145
ERE91-51	PR	0.0019	1.9977	0.00095	ERE91-52	PR	0.0031	1.9969	0.00155
ERE91-51	FW	0.0023	1.9977	0.00115	ERE91-52	PR	0.0034	1.9966	0.00170
ERE91-51	FW	0.0025	1.9975	0.00125	ERE91-53	PR	0.0012	1.9985	0.00060
ERE91-51	FW	0.0026	1.9974	0.00130	ERE91-53	PR	0.0011	1.9981	0.00055
ERE91-51	FW	0.0030	1.9969	0.00150	ERE91-53	FW	0.0013	1.9980	0.00065
ERE91-51	FW	0.0025	1.9973	0.00125	ERE91-53	PR	0.0010	1.9985	0.00050
ERE91-51	FW	0.0029	1.9966	0.00145	ERE91-53	PR	0.0009	1.9985	0.00045
ERE91-51B	PR	0.0035	1.9963	0.00175	ERE91-53	FW	0.0014	1.9986	0.00070
ERE91-51B	PR	0.0034	1.9966	0.00170	ERE91-53	FW	0.0012	1.9988	0.00060
ERE91-51B	PR	0.0025	1.9975	0.00125	ERE91-53	FW	0.0013	1.9987	0.00065
ERE91-51B	PR	0.0022	1.9978	0.00110	ERE91-53	RN	0.0013	1.9985	0.00065
ERE91-51B	PR	0.0026	1.9970	0.00130	ERE91-53	PR	0.0013	1.9986	0.00065
ERE91-51 B	PR	0.0031	1.9969	0.00155	ERE91-53	PR	0.0014	1.9986	0.00070
ERE91-51 B	FW	0.0014	1.9986	0.00070	ERE91-53	RN	0.0011	1.9989	0.00055
ERE91-51B	FW	0.0013	1.9987	0.00065	ERE91-54	PR	0.0044	1.9950	0.00221
ERE91-51 B	FW	0.0013	1.9987	0.00065	ERE91-54	RN	0.0026	1.9956	0.00130
ERE91-51B	FW	0.0014	1.9986	0.00070	ERE91-54	PR	0.0039	1.9947	0.00196
ERE91-51 B	RN	0.0011	1.9987	0.00055	ERE91-54	PR	0.0044	1.9947	0.00221
ERE91-51B	RN	0.0015	1.9985	0.00075	ERE91-54	FW	0.0029	1.9960	0.00145
ERE91-52	FW	0.0034	1.9966	0.00170	ERE91-54	FW	0.0028	1.9964	0.00140
ERE91-52	PR	0.0031	1.9969	0.00155	ERE91-54	RN	0.0027	1.9963	0.00135
ERE91-52	RN	0.0029	1.9970	0.00145	ERE91-54	RN	0.0029	1.9965	0.00145
ERE91-52	PR	0.0026	1.9970	0.00130	ERE91-54	PR	0.0046	1.9947	0.00231

Appendix B. (continued)

FISH ID	SAMPLE SITE	SR LEVEL	CA LEVEL	SRCA RATIO
ERE91-54	PR	0.0040	1.9946	0.00201
ERE91-54	FW	0.0030	1.9962	0.00150
ERE91-55	PR	0.0023	1.9976	0.00115
ERE91-55	PR	0.0021	1.9970	0.00105
ERE91-55	PR	0.0027	1.9968	0.00135
ERE91-55	PR	0.0024	1.9969	0.00120
ERE91-55	PR	0.0029	1.9970	0.00145
ERE91-55	PR	0.0026	1.9974	0.00130
ERE91-55	*RN*	0.0022	1.9973	0.00110
ERE91-55	*RN*	0.0028	1.9972	0.00140
ERE91-55	*RN*	0.0025	1.9973	0.00125
ERE91-55	FW	0.0028	1.9972	0.00140
ERE91-55	FW	0.0024	1.9971	0.00120
ERE91-55	*RN*	0.0025	1.9970	0.00125
ERE91-56	RN	0.0035	1.9960	0.00175
ERE91-56	RN	0.0031	1.9969	0.00155
ERE91-56	FW	0.0030	1.9967	0.00150
ERE91-56	FW	0.0031	1.9969	0.00155
ERE91-56	*RN*	0.0034	1.9964	0.00170
ERE91-56	PR	0.0013	1.9987	0.00065
ERE91-56	PR	0.0011	1.9989	0.00055
ERE91-56	PR	0.0011	1.9986	0.00055
ERE91-56	PR	0.0012	1.9988	0.00060
ERE91-56	*RN*	*0.0032*	1.9968	0.00160
ERE91-56	PR	0.0009	1.9991	0.00045
ERE91-56	PR	0.0011	1.9989	0.00055
ERE91-58	PR	0.0035	1.9956	0.00175
ERE91-58	*RN*	0.0030	1.9954	0.00150
ERE91-58	FW	0.0025	1.9961	0.00125
ERE91-58	FW	0.0023	1.9969	0.00115
ERE91-58	FW	0.0025	1.9966	0.00125
ERE91-58	FW	0.0029	1.9960	0.00145
ERE91-58	*RN*	0.0025	1.9967	0.00125
ERE91-58	PR	0.0038	1.9940	0.00191
ERE91-58	PR	0.0038	1.9941	0.00191
ERE91-58	PR	0.0040	1.9942	0.00201
ERE91-58	PR	0.0036	1.9955	0.00180
ERE91-58	PR	0.0036	1.9952	0.00180
ERE91-59	FW	0.0035	1.9962	0.00175
ERE91-59	PR	0.0013	1.9981	0.00065
ERE91-59	FW	0.0034	1.9962	0.00170
ERE91-59	PR	0.0016	1.9981	0.00080
ERE91-59	PR	0.0012	1.9980	0.00060
ERE91-59	PR	0.0014	1.9976	0.00070
ERE91-59	RN	0.0029	1.9964	0.00145
ERE91-59	FW	0.0034	1.9963	0.00170
ERE91-59	*RN*	0.0037	1.9952	0.00185
ERE91-59	PR	0.0011	1.9980	0.00055
ERE91-59	PR	0.0012	1.9978	0.00060
ERE91-59	*RN*	*0.0030*	1.9970	0.00150
ERE91-6	PR	0.0020	1.9926	0.00100
ERE91-60	PR	0.0012	1.9988	0.00060
ERE91-60	FW	*0.0012*	1.9988	0.00060
ERE91-60	*RN*	0.0013	1.9980	0.00065
ERE91-60	PR	0.0011	1.9989	0.00055
ERE91-60	PR	0.0011	1.9986	0.00055
ERE91-60	PR	0.0008	1.9988	0.00040
ERE91-60	PR	0.0010	1.9987	0.00050

Appendix B. (continued)

FISH ID	SAMPLE SITE	SR LEVEL	CA LEVEL	SRCA RATIO
ERE91-60	PR	0.0011	1.9987	0.00055
ERE91-60	FW	0.0012	1.9988	0.00060
ERE91-60	FW	0.0014	1.9973	0.00070
ERE91-60	FW	0.0017	1.9983	0.00085
ERE91-60	FW	0.0012	1.9988	0.00060
ERE91-61	PR	0.0039	1.9956	0.00195
ERE91-61	PR	0.0048	1.9948	0.00241
ERE91-61	PR	0.0048	1.9942	0.00241
ERE91-61	PR	0.0046	1.9951	0.00231
ERE91-61	PR	0.0046	1.9951	0.00231
ERE91-61	PR	0.0041	1.9942	0.00206
ERE91-61	FW	0.0028	1.9969	0.00140
ERE91-61	FW	0.0027	1.9964	0.00135
ERE91-61	FW	0.0026	1.9974	0.00130
ERE91-61	FW	0.0024	1.9974	0.00120
ERE91-61	FW	0.0028	1.9964	0.00140
ERE91-61	FW	0.0026	1.9961	0.00130
ERE91-62	FW	0.0028	1.9919	0.00141
ERE91-62	PR	0.0027	1.9915	0.00136
ERE91-62	PR	0.0027	1.9921	0.00136
ERE91-62	FW	0.0032	1.9924	0.00161
ERE91-62	FW	0.0033	1.9917	0.00166
ERE91-62	FW	0.0032	1.9914	0.00161
ERE91-62	FW	0.0029	1.9920	0.00146
ERE91-62	PR	0.0033	1.9906	0.00166
ERE91-62	PR	0.0029	1.9915	0.00146
ERE91-62	PR	0.0030	1.9912	0.00151
ERE91-62	PR	0.0036	1.9918	0.00181

FISH ID	SAMPLE SITE	SR LEVEL	CA LEVEL	SRCA RATIO
ERE91-62	FW	0.0030	1.9928	0.00151
ERE91-63	FW	0.0018	1.9982	0.00090
ERE91-63	FW	0.0028	1.9971	0.00140
ERE91-63	PR	0.0015	1.9981	0.00075
ERE91-63	FW	0.0029	1.9971	0.00145
ERE91-63	PR	0.0019	1.9979	0.00095
ERE91-63	PR	0.0018	1.9975	0.00090
ERE91-63	PR	0.0013	1.9986	0.00065
ERE91-63	PR	0.0018	1.9976	0.00090
ERE91-63	PR	0.0019	1.9978	0.00095
ERE91-63	FW	0.0024	1.9974	0.00120
ERE91-63	FW	0.0025	1.9974	0.00125
ERE91-63	FW	0.0025	1.9975	0.00125
ERE91-65	PR	0.0012	1.9976	0.00060
ERE91-65	PR	0.0011	1.9975	0.00055
ERE91-65	PR	0.0011	1.9989	0.00055
ERE91-65	PR	0.0012	1.9977	0.00060
ERE91-65	PR	0.0013	1.9982	0.00065
ERE91-65	PR	0.0009	1.9979	0.00045
ERE91-65	FW	0.0029	1.9971	0.00145
ERE91-65	FW	0.0032	1.9967	0.00160
ERE91-65	FW	0.0030	1.9970	0.00150
ERE91-65	FW	0.0024	1.9976	0.00120
ERE91-65	FW	0.0027	1.9971	0.00135
ERE91-65	FW	0.0030	1.9970	0.00150
ERE91-66	PR	0.0044	1.9956	0.00220
ERE91-66	PR	0.0046	1.9954	0.00231
ERE91-66	PR	0.0048	1.9950	0.00241

Appendix B. (continued)

FISH ID	SAMPLE SITE	SR LEVEL	CA LEVEL	SRCA RATIO
ERE91-66	PR	0.0032	1.9961	0.00160
ERE91-66	PR	0.0035	1.9958	0.00175
ERE91-66	FW	0.0026	1.9972	0.00130
ERE91-66	FW	0.0023	1.9976	0.00115
ERE91-66	FW	0.0032	1.9968	0.00160
ERE91-66	RN	0.0025	1.9975	0.00125
ERE91-66	RN	0.0028	1.9964	0.00140
ERE91-66	RN	0.0024	1.9973	0.00120
RE91-03	FW	0.0013	1.9609	0.00066
RE91-03	FW	0.0014	1.9584	0.00071
RE91-03	PR	0.0012	1.9778	0.00061
RE91-03	RN	0.0016	1.9606	0.00082
RE91-03	FW	0.0018	1.9611	0.00092
RE91-03	FW	0.0015	1.9601	0.00077
RE91-03	PR	0.0014	1.9583	0.00071
RE91-03	PR	0.0018	1.9587	0.00092
RE91-03	FW	0.0012	1.9621	0.00061
RE91-03	PR	0.0019	1.9604	0.00097
RE91-03	PR	0.0021	1.9555	0.00107
RE91-03	PR	0.0019	1.9585	0.00097
RE91-04	FW	0.0013	1.9981	0.00065
RE91-04	PR	0.0018	1.9962	0.00090
RE91-04	FW	0.0013	1.9983	0.00065
RE91-04	FW	0.0011	1.9989	0.00055
RE91-04	RN	0.0010	1.9990	0.00050
RE91-04	PR	0.0019	1.9963	0.00095
RE91-04	RN	0.0010	1.9984	0.00050
RE91-04	PR	0.0021	1.9969	0.00105
RE91-04	FW	0.0010	1.9987	0.00050
RE91-04	PR	0.0020	1.9958	0.00100

FISH ID	SAMPLE SITE	SR LEVEL	CA LEVEL	SRCA RATIO
RE91-04	PR	0.0021	1.9958	0.00105
RE91-05	PR	0.0016	1.9951	0.00080
RE91-05	FW	0.0008	1.9976	0.00040
RE91-05	FW	0.0010	1.9971	0.00050
RE91-05	FW	0.0016	1.9969	0.00080
RE91-05	FW	0.0013	1.9970	0.00065
RE91-05	FW	0.0014	1.9963	0.00070
RE91-05	FW	0.0011	1.9974	0.00055
RE91-05	PR	0.0015	1.9954	0.00075
RE91-05	PR	0.0016	1.9939	0.00080
RE91-05	PR	0.0020	1.9942	0.00100
RE91-05	PR	0.0018	1.9944	0.00090
RE91-05	PR	0.0019	1.9952	0.00095
RE91-06	PR	0.0014	1.9938	0.00070
RE91-06	PR	0.0012	1.9946	0.00060
RE91-06	FW	0.0010	1.9986	0.00050
RE91-06	PR	0.0011	1.9967	0.00055
RE91-06	PR	0.0011	1.9948	0.00055
RE91-06	PR	0.0014	1.9947	0.00070
RE91-06	FW	0.0009	1.9991	0.00045
RE91-06	FW	0.0010	1.9988	0.00050
RE91-06	PR	0.0012	1.9934	0.00060
RE91-06	FW	0.0011	1.9988	0.00055
RE91-06	FW	0.0008	1.9989	0.00040
RE91-06	FW	0.0013	1.9986	0.00065
RE91-08	RN	0.0013	1.9970	0.00065
RE91-08	FW	0.0009	1.9973	0.00045
RE91-08	FW	0.0010	1.9972	0.00050
RE91-08	PR	0.0012	1.9951	0.00060

Appendix B. (continued)

FISH ID	SAMPLE SITE	SR LEVEL	CA LEVEL	SRCA RATIO	FISH ID	SAMPLE SITE	SR LEVEL	CA LEVEL	SRCA RATIO
RE91-08	FW	0.0013	1.9964	0.00065	RE91-10	PR	0.0028	1.9932	0.00140
RE91-08	FW	0.0013	1.9967	0.00065	RE91-10	PR	0.0029	1.9924	0.00146
RE91-08	FW	0.0012	1.9967	0.00060	RE91-10	PR	0.0032	1.9926	0.00161
RE91-08	PR	0.0009	1.9956	0.00045	RE91-10BP	PR	0.0030	1.9929	0.00151
RE91-08	PR	0.0012	1.9935	0.00060	RE91-10BP	PR	0.0034	1.9906	0.00171
RE91-08	PR	0.0016	1.9934	0.00080	RE91-10BP	FW	0.0010	1.9960	0.00050
RE91-08	PR	0.0012	1.9958	0.00060	RE91-10BP	PR	0.0028	1.9941	0.00140
RE91-08	PR	0.0013	1.9964	0.00065	RE91-10BP	PR	0.0026	1.9938	0.00130
RE91-09	FW	0.0009	1.9991	0.00045	RE91-10BP	PR	0.0029	1.9938	0.00145
RE91-09	FW	0.0012	1.9988	0.00060	RE91-10BP	FW	0.0013	1.9956	0.00065
RE91-09	FW	0.0013	1.9987	0.00065	RE91-10BP	FW	0.0011	1.9952	0.00055
RE91-09	FW	0.0014	1.9981	0.00070	RE91-10BP	FW	0.0009	1.9953	0.00045
RE91-09	FW	0.0015	1.9985	0.00075	RE91-10BP	FW	0.0010	1.9954	0.00050
RE91-09	FW	0.0016	1.9981	0.00080	RE91-10BP	PR	0.0031	1.9922	0.00156
RE91-09	PR	0.0007	1.9916	0.00035	RE91-10BP	FW	0.0010	1.9947	0.00050
RE91-09	PR	0.0014	1.9961	0.00070	RE91-12	FW	0.0013	1.9976	0.00065
RE91-09	PR	0.0016	1.9969	0.00080	RE91-12	FW	0.0013	1.9976	0.00065
RE91-09	PR	0.0018	1.9961	0.00090	RE91-12	FW	0.0013	1.9972	0.00065
RE91-09	PR	0.0018	1.9963	0.00090	RE91-12	FW	0.0011	1.9977	0.00055
RE91-09	PR	0.0019	1.9972	0.00095	RE91-12	FW	0.0009	1.9972	0.00045
RE91-10	FW	0.0010	1.9961	0.00050	RE91-12	FW	0.0007	1.9976	0.00035
RE91-10	FW	0.0013	1.9949	0.00065	RE91-12	PR	0.0018	1.9932	0.00090
RE91-10	FW	0.0013	1.9955	0.00065	RE91-12	PR	0.0018	1.9925	0.00090
RE91-10	FW	0.0013	1.9956	0.00065	RE91-12	PR	0.0017	1.9954	0.00085
RE91-10	FW	0.0015	1.9946	0.00075	8E91-12	PR	0.0016	1.9934	0.00080
RE91-10	FW	0.0018	1.9948	0.00090	RE91-12	PR	0.0013	1.9910	0.00065
RE91-10	PR	0.0020	1.9932	0.00100	RE91-12	PR	0.0011	1.9955	0.00055
RE91-10	PR	0.0023	1.9939	0.00115	RE91-13	FW	0.0013	1.9987	0.00065
RE91-10	PR	0.0026	1.9933	0.00130	RE91-13	FW	0.0011	1.9989	0.00055

Appendix B. (continued)

FISH ID	SAMPLE SITE	SR LEVEL	CA LEVEL	SRCA RATIO
RE91-13	PR	0.0013	1.9971	0.00065
RE91-13	FW	0.0014	1.9983	0.00070
RE91-13	PR	0.0013	1.9964	0.00065
RE91-13	FW	0.0012	1.9987	0.00060
RE91-13	PR	0.0011	1.9977	0.00055
RE91-13	FW	0.0014	1.9984	0.00070
RE91-13	FW	0.0013	1.9987	0.00065
RE91-13	PR	0.0011	1.9973	0.00055
RE91-13	PR	0.0011	1.9971	0.00055
RE91-13	PR	0.0014	1.9961	0.00070
RE91-15	FW	0.0016	1.9984	0.00080
RE91-15	PR	0.0017	1.9965	0.00085
RE91-15	PR	0.0017	1.9970	0.00085
RE91-15	PR	0.0011	1.9973	0.00055
RE91-15	PR	0.0012	1.9969	0.00060
RE91-15	FW	0.0016	1.9980	0.00080
RE91-15	FW	0.0014	1.9986	0.00070
RE91-15	FW	0.0016	1.9979	0.00080
RE91-15	FW	0.0015	1.9984	0.00075
RE91-15	PR	0.0014	1.9982	0.00070
RE91-15	PR	0.0015	1.9976	0.00075
RE91-15	FW	0.0014	1.9986	0.00070
RE91-16	FW	0.0009	1.9927	0.00045
RE91-16	FW	0.0009	1.9931	0.00045
RE91-16	PR	0.0029	1.9900	0.00146
RE91-16	FW	0.0013	1.9924	0.00065
RE91-16	PR	0.0012	1.9875	0.00060
RE91-16	FW	0.0011	1.9922	0.00055
RE91-16	PR	0.0017	1.9913	0.00085

FISH ID	SAMPLE SITE	SR LEVEL	CA LEVEL	SRCA RATIO
RE91-16	FW	0.0008	1.9932	0.00040
RE91-16	FW	0.0008	1.9930	0.00040
RE91-16	PR	0.0032	1.9898	0.00161
RE91-16	PR	0.0024	1.9894	0.00121
RE91-16	PR	0.0014	1.9897	0.00070
RE91-18	PR	0.0019	1.9979	0.00095
RE91-18	FW	0.0015	1.9985	0.00075
RE91-18	PR	0.0017	1.9983	0.00085
RE91-18	FW	0.0010	1.9990	0.00050
RE91-18	FW	0.0012	1.9988	0.00060
RE91-18	FW	0.0016	1.9981	0.00080
RE91-18	PR	0.0032	1.9967	0.00160
RE91-18	PR	0.0021	1.9978	0.00105
RE91-18	PR	0.0023	1.9972	0.00115
RE91-18	FW	0.0014	1.9986	0.00070
RE91-18	PR	0.0025	1.9975	0.00125
RE91-18	FW	0.0013	1.9982	0.00065
RE91-19	PR	0.0015	1.9975	0.00075
RE91-19	PR	0.0015	1.9978	0.00075
RE91-19	PR	0.0016	1.9973	0.00080
RE91-19	PR	0.0016	1.9977	0.00080
RE91-19	PR	0.0017	1.9976	0.00085
RE91-19	PR	0.0020	1.9978	0.00100
8E91-19	FW	0.0010	1.9985	0.00050
RE91-19	FW	0.0011	1.9989	0.00055
RE91-19	FW	0.0013	1.9986	0.00065
RE91-19	FW	0.0013	1.9986	0.00065
RE91-19	FW	0.0013	1.9987	0.00065
RE91-19	FW	0.0016	1.9983	0.00080

Appendix B. (continued)

FISH ID	SAMPLE SITE	SR LEVEL	CA LEVEL	SRCA RATIO	FISH ID	SAMPLE SITE	SR LEVEL	CA LEVEL	SRCA RATIO
RE91-20	PR	0.0033	1.9961	0.00165	RE91-20BP	PR	0.0029	1.9968	0.00145
RE91-20	PR	0.0032	1.9963	0.00160	RE91-20BP	FW	0.0013	1.9987	0.00065
RE91-20	PR	0.0026	1.9959	0.00130	RE91-20BP	FW	0.0012	1.9986	0.00060
RE91-20	FW	0.0012	1.9986	0.00060	RE91-20BP	FW	0.0013	1.9986	0.00065
RE91-20	FW	0.0012	1.9987	0.00060	RE91-20BP	FW	0.0011	1.9988	0.00055
RE91-20	FW	0.0012	1.9988	0.00060	RE91-20BP	PR	0.0035	1.9954	0.00175
RE91-20	PR	0.0024	1.9955	0.00120	RE91-20BP	FW	0.0018	1.9982	0.00090
RE91-20	PR	0.0018	1.9965	0.00090	RE91-22	FW	0.0012	1.9988	0.00060
RE91-20	PR	0.0018	1.9964	0.00090	RE91-22	FW	0.0013	1.9987	0.00065
RE91-20	FW	0.0013	1.9986	0.00065	8E91-22	FW	0.0010	1.9990	0.00050
RE91-20	FW	0.0014	1.9979	0.00070	RE91-22	PR	0.0013	1.9960	0.00065
RE91-20	FW	0.0016	1.9982	0.00080	RE91-22	PR	0.0014	1.9958	0.00070
RE91-20B	PR	0.0029	1.9910	0.00146	RE91-22	PR	0.0014	1.9966	0.00070
RE91-20B	FW	0.0009	1.9947	0.00045	RE91-22	PR	0.0010	1.9982	0.00050
RE91-20B	FW	0.0014	1.9933	0.00070	RE91-22	PR	0.0012	1.9963	0.00060
RE91-20B	PR	0.0030	1.9915	0.00151	RE91-22	FW	0.0016	1.9984	0.00080
RE91-20B	RN	0.0013	1.9938	0.00065	RE91-22	FW	0.0011	1.9988	0.00055
RE91-20B	PR	0.0034	1.9921	0.00171	RE91-22	FW	0.0014	1.9986	0.00070
RE91-20B	PR	0.0019	1.9911	0.00095	RE91-22	PR	0.0010	1.9975	0.00050
RE91-20B	PR	0.0016	1.9912	0.00080	RE91-23	FW	0.0009	1.9954	0.00045
RE91-20B	PR	0.0021	1.9918	0.00105	RE91-23	FW	0.0011	1.9958	0.00055
RE91-20B	FW	0.0009	1.9944	0.00045	RE91-23	FW	0.0012	1.9958	0.00060
RE91-20B	FW	0.0013	1.9936	0.00065	RE91-23	FW	0.0018	1.9957	0.00090
RE91-20B	FW	0.0011	1.9935	0.00055	RE91-23	FW	0.0013	1.9961	0.00065
RE91-20BP	FW	0.0011	1.9989	0.00055	RE91-23	FW	0.0013	1.9956	0.00065
RE91-20BP	PR	0.0029	1.9967	0.00145	RE91-23	PR	0.0015	1.9923	0.00075
RE91-20BP	PR	0.0029	1.9960	0.00145	RE91-23	PR	0.0012	1.9930	0.00060
RE91-20BP	PR	0.0032	1.9955	0.00160	RE91-23	PR	0.0012	1.9929	0.00060
RE91-20BP	PR	0.0026	1.9973	0.00130	RE91-23	PR	0.0012	1.9906	0.00060

Appendix B. (continued)

FISH ID	SAMPLE SITE	SR LEVEL	CA LEVEL	SRCA RATIO
RE91-23	PR	0.0011	1.9921	0.00055
RE91-23	PR	0.0008	1.9932	0.00040
RE91-24	FW	0.0013	1.9985	0.00065
RE91-24	PR	0.0045	1.9952	0.00226
RE91-24	PR	0.0047	1.9948	0.00236
RE91-24	FW	0.0013	1.9986	0.00065
RE91-24	PR	0.0043	1.9955	0.00215
RE91-24	FW	0.0012	1.9988	0.00060
RE91-24	FW	0.0011	1.9989	0.00055
RE91-24	FW	0.0011	1.9989	0.00055
RE91-24	FW	0.0008	1.9992	0.00040
RE91-24	PR	0.0048	1.9949	0.00241
RE91-24	PR	0.0045	1.9952	0.00226
8E91-24	PR	0.0045	1.9954	0.00226
RE91-25	PR	0.0015	1.9968	0.00075
RE91-25	PR	0.0013	1.9972	0.00065
RE91-25	PR	0.0013	1.9972	0.00065
RE91-25	PR	0.0013	1.9964	0.00065
RE91-25	FW	0.0007	1.9975	0.00035
RE91-25	PR	0.0013	1.9970	0.00065
RE91-25	PR	0.0013	1.9965	0.00065
RE91-25	PR	0.0010	1.9965	0.00050
RE91-25	*FW*	0.0018	1.9964	0.00090
RE91-25	FW	0.0015	1.9964	0.00075
RE91-25	FW	0.0010	1.9971	0.00050
RE91-25	PR	0.0012	1.9968	0.00060
RE91-25	FW	0.0013	1.9971	0.00065
RE91-25	FW	0.0012	1.9969	0.00060
RE91-26	FW	0.0009	1.9991	0.00045

FISH ID	SAMPLE SITE	SR LEVEL	CA LEVEL	SRCA RATIO
RE91-26	FW	0.0011	1.9989	0.00055
RE91-26	FW	0.0012	1.9988	0.00060
RE91-26	FW	0.0013	1.9987	0.00065
RE91-26	FW	0.0015	1.9985	0.00075
RE91-26	FW	0.0017	1.9982	0.00085
RE91-26	PR	0.0018	1.9982	0.00090
RE91-26	PR	0.0019	1.9981	0.00095
RE91-26	PR	0.0019	1.9981	0.00095
RE91-26	PR	0.0020	1.9980	0.00100
RE91-26	PR	0.0020	1.9980	0.00100
RE91-26	PR	0.0022	1.9978	0.00110
RE91-27	PR	0.0019	1.9930	0.00095
RE91-27	PR	0.0018	1.9961	0.00090
RE91-27	PR	0.0015	1.9960	0.00075
RE91-27	PR	0.0014	1.9962	0.00070
RE91-27	PR	0.0013	1.9968	0.00065
RE91-27	FW	0.0013	1.9987	0.00065
RE91-27	*RN*	0.0013	1.9987	0.00065
RE91-27	FW	0.0013	1.9987	0.00065
RE91-27	FW	0.0011	1.9987	0.00055
RE91-27	*RN*	0.0011	1.9986	0.00055
RE91-27	FW	*0.0010*	1.9990	0.00050
RE91-27B	PR	0.0022	1.9952	0.00110
RE91-27B	PR	0.0019	1.9964	0.00095
RE91-27B	NU	0.0013	1.9987	0.00065
RE91-27B	NU	0.0014	1.9986	0.00070
RE91-27B	NU	0.0013	1.9984	0.00065
RE91-27B	NU	0.0013	1.9979	0.00065
RE91-27B	NU	0.0009	1.9991	0.00045

Appendix B. (continued)

FISH ID	SAMPLE SITE	SR LEVEL	CA LEVEL	SRCA RATIO	FISH ID	SAMPLE SITE	SR LEVEL	CA LEVEL	SRCA RATIO
RE91-27B	FW	0.0011	1.9983	0.00055	RE91-30	PR	0.0010	1.9938	0.00050
RE91-27B	FW	0.0008	1.9992	0.00040	RE91-30	PR	0.0014	1.9956	0.00070
RE91-27B	PR	0.0022	1.9975	0.00110	RE91-30	PR	0.0014	1.9930	0.00070
RE91-27B	PR	0.0021	1.9979	0.00105	RE91-30	PR	0.0011	1.9941	0.00055
RE91-27B	FW	0.0012	1.9988	0.00060	RE91-31	FW	0.0011	1.9989	0.00055
RE91-27B	NU	0.0010	1.9987	0.00050	RE91-31	FW	0.0014	1.9986	0.00070
RE91-27B	FW	0.0009	1.9989	0.00045	RE91-31	FW	0.0012	1.9988	0.00060
RE91-27B	FW	0.0011	1.9983	0.00055	RE91-31	FW	0.0011	1.9983	0.00055
RE91-27B	FW	0.0015	1.9984	0.00075	RE91-31	FW	0.0009	1.9991	0.00045
RE91-28	PR	0.0030	1.9946	0.00150	RE91-31	PR	0.0009	1.9980	0.00045
RE91-28	FW	0.0011	1.9972	0.00055	RE91-31	PR	0.0011	1.9973	0.00055
RE91-28	PR	0.0018	1.9943	0.00090	RE91-31	PR	0.0012	1.9971	0.00060
RE91-28	PR	0.0020	1.9942	0.00100	RE91-31	PR	0.0015	1.9972	0.00075
RE91-28	PR	0.0020	1.9935	0.00100	RE91-31	FW	0.0013	1.9986	0.00065
RE91-28	FW	0.0016	1.9969	0.00080	RE91-31	PR	0.0013	1.9960	0.00065
RE91-28	PR	0.0024	1.9933	0.00120	RE91-31	PR	0.0010	1.9978	0.00050
RE91-28	PR	0.0028	1.9935	0.00140	RE91-32	PR	0.0010	1.9988	0.00050
RE91-28	FW	0.0014	1.9962	0.00070	RE91-32	PR	0.0009	1.9988	0.00045
RE91-28	FW	0.0015	1.9968	0.00075	RE91-32	PR	0.0009	1.9981	0.00045
RE91-28	FW	0.0013	1.9975	0.00065	RE91-32	PR	0.0012	1.9976	0.00060
RE91-28	FW	0.0014	1.9971	0.00070	RE91-32	PR	0.0013	1.9981	0.00065
RE91-30	PR	0.0016	1.9947	0.00080	RE91-32	PR	0.0012	1.9988	0.00060
RE91-30	RN	0.0013	1.9968	0.00065	RE91-32	RN	0.0012	1.9988	0.00060
RE91-30	RN	0.0011	1.9973	0.00055	RE91-32	FW	0.0016	1.9982	0.00080
RE91-30	RN	0.0012	1.9968	0.00060	RE91-32	RN	0.0011	1.9982	0.00055
RE91-30	FW	0.0010	1.9972	0.00050	RE9132	FW	0.0009	1.9990	0.00045
RE91-30	PR	0.0009	1.9941	0.00045	RE91-32	FW	0.0011	1.9988	0.00055
RE91-30	FW	0.0014	1.9971	0.00070	RE91-32	RN	0.0010	1.9985	0.00050
RE91-30	RN	0.0010	1.9973	0.00050	RE91-33	PR	0.0038	1.9946	0.00191

Appendix B. (continued)

FISH ID	SAMPLE SITE	SR LEVEL	CA LEVEL	SRCA RATIO	FISH ID	SAMPLE SITE	SR LEVEL	CA LEVEL	SRCA RATIO
RE91-33	PR	0.0037	1.9948	0.00185	RE91-36BP	FW	0.0015	1.9984	0.00075
RE91-33	PR	0.0037	1.9939	0.00186	RE91-36BP	FW	0.0014	1.9984	0.00070
RE91-33	PR	0.0036	1.9955	0.00180	RE9136BP	FW	0.0015	1.9984	0.00075
RE91-33	PR	0.0033	1.9952	0.00165	RE91-36BP	FW	0.0013	1.9986	0.00065
RE91-33	PR	0.0030	1.9939	0.00150	RE91-36BP	FW	0.0012	1.9988	0.00060
8E91-33	FW	0.0014	1.9985	0.00070	RE91-36BP	FW	0.0009	1.9991	0.00045
RE91-33	RN	0.0014	1.9979	0.00070	RE91-38	FW	0.0018	1.9978	0.00090
RE91-33	FW	0.0014	1.9978	0.00070	RE91-38	FW	0.0016	1.9984	0.00080
RE91-33	FW	0.0013	1.9987	0.00065	RE91-38	PR	0.0012	1.9988	0.00060
RE91-33	FW	0.0007	1.9991	0.00035	RE91-38	RN	0.0014	1.9984	0.00070
RE91-33	FW	0.0007	1.9980	0.00035	RE91-38	FW	0.0013	1.9987	0.00065
RE91-36	FW	0.0011	1.9989	0.00055	RE91-38	FW	0.0014	1.9986	0.00070
RE91-36	PR	0.0021	1.9979	0.00105	RE91-38	PR	0.0014	1.9986	0.00070
RE91-36	PR	0.0019	1.9963	0.00095	RE91-38	PR	0.0007	1.9992	0.00035
RE91-36	FW	0.0011	1.9989	0.00055	RE91-38	PR	0.0009	1.9991	0.00045
RE91-36	FW	0.0013	1.9987	0.00065	RE91-38	PR	0.0012	1.9988	0.00060
RE91-36	FW	0.0009	1.9991	0.00045	RE91-38	PR	0.0013	1.9984	0.00065
RE91-36	FW	0.0014	1.9986	0.00070	RE91-38	FW	0.0013	1.9987	0.00065
RE91-36	PR	0.0018	1.9968	0.00090	RE91-41	PR	0.0036	1.9951	0.00180
RE91-36	PR	0.0015	1.9962	0.00075	RE91-41	PR	0.0036	1.9922	0.00181
RE91-36	PR	0.0026	1.9961	0.00130	RE91-41	PR	0.0035	1.9912	0.00176
RE91-36	PR	0.0025	1.9975	0.00125	RE91-41	PR	0.0031	1.9931	0.00156
RE91-36	FW	0.0018	1.9982	0.00090	RE91-41	FW	0.0015	1.9981	0.00075
RE91-36BP	PR	0.0030	1.9970	0.00150	RE91-41	PR	0.0035	1.9931	0.00176
RE91-36BP	PR	0.0028	1.9972	0.00140	RE91-41	FW	0.0012	1.9981	0.00060
RE91-36BP	PR	0.0022	1.9977	0.00110	RE91-41	RN	0.0013	1.9987	0.00065
RE91-36BP	PR	0.0020	1.9971	0.00100	RE91-41	FW	0.0010	1.9987	0.00050
RE91-36BP	PR	0.0020	1.9964	0.00100	8E91-41	RN	0.0010	1.9988	0.00050
RE91-36BP	PR	0.0017	1.9966	0.00085	RE91-41	RN	0.0009	1.9989	0.00045

Appendix B. (continued)

FISH ID	SAMPLE SITE	SR LEVEL	CA LEVEL	SRCA RATIO	FISH ID	SAMPLE SITE	SR LEVEL	CA LEVEL	SRCA RATIO
RE91-41	PR	0.0032	1.9949	0.00160	RE91-44	PR	0.0035	1.9945	0.00175
RE91-42	PR	0.0021	1.9965	0.00105	RE91-44	PR	0.0031	1.9955	0.00155
RE91-42	FW	0.0011	1.9985	0.00055	RE91-44	FW	0.0015	1.9979	0.00075
RE91-42	PR	0.0022	1.9958	0.00110	RE91-44	FW	0.0012	1.9987	0.00060
RE91-42	PR	0.0021	1.9965	0.00105	RE91-44	FW	0.0009	1.9991	0.00045
RE91-42	PR	0.0019	1.9966	0.00095	RE91-44	FW	0.0012	1.9988	0.00060
RE91-42	FW	0.0009	1.9991	0.00045	RE91-44	FW	0.0013	1.9983	0.00065
RE91-42	FW	0.0014	1.9986	0.00070	RE91-45	PR	0.0013	1.9920	0.00065
RE91-42	FW	0.0013	1.9986	0.00065	RE91-45	PR	0.0016	1.9908	0.00080
RE91-42	PR	0.0016	1.9968	0.00080	RE91-45	PR	0.0011	1.9917	0.00055
RE91-42	FW	0.0010	1.9990	0.00050	RE91-45	PR	0.0011	1.9916	0.00055
RE91-42	FW	0.0012	1.9988	0.00060	RE91-45	PR	0.0014	1.9921	0.00070
RE91-43	FW	0.0009	1.9982	0.00045	RE91-45	PR	0.0010	1.9932	0.00050
RE91-43	FW	0.0012	1.9980	0.00060	RE91-45	FW	0.0014	1.9939	0.00070
RE91-43	FW	0.0013	1.9981	0.00065	RE91-45	FW	0.0015	1.9671	0.00076
RE91-43	FW	0.0014	1.9981	0.00070	RE91-45	FW	0.0010	1.9937	0.00050
RE91-43	FW	0.0015	1.9976	0.00075	RE91-45	FW	0.0013	1.9944	0.00065
RE91-43	FW	0.0015	1.9979	0.00075	RE91-45	FW	0.0010	1.9940	0.00050
RE91-43	PR	0.0012	1.9979	0.00060	RE91-45	FW	0.0010	1.9942	0.00050
RE91-43	PR	0.0012	1.9985	0.00060	RE91-46	FW	0.0009	1.9991	0.00045
RE91-43	PR	0.0013	1.9979	0.00065	RE91-46	FW	0.0011	1.9989	0.00055
RE91-43	PR	0.0014	1.9981	0.00070	RE91-46	FW	0.0011	1.9989	0.00055
RE91-43	PR	0.0013	1.9982	0.00065	RE91-46	FW	0.0013	1.9987	0.00065
RE91-43	PR	0.0018	1.9969	0.00090	RE91-46	FW	0.0014	1.9986	0.00070
RE91-44	FW	0.0012	1.9976	0.00060	RE91-46	FW	0.0015	1.9985	0.00075
RE91-44	PR	0.0039	1.9949	0.00196	RE91-46	PR	0.0034	1.9955	0.00170
RE91-44	PR	0.0031	1.9932	0.00156	RE91-46	PR	0.0035	1.9903	0.00176
RE91-44	PR	0.0037	1.9932	0.00186	RE91-4 6	PR	0.0038	1.9947	0.00191
RE91-44	PR	0.0033	1.9951	0.00165	RE91-46	PR	0.0041	1.9959	0.00205

Appendix B. (continued)

FISH ID	SAMPLE SITE	SR LEVEL	CA LEVEL	SRCA RATIO
RE91-46	PR	0.0042	1.9954	0.00210
RE91-46	PR	0.0043	1.9957	0.00215
RE91-48	PR	0.0023	1.9964	0.00115
RE91-48	PR	0.0021	1.9962	0.00105
RE91-48	PR	0.0019	1.9965	0.00095
RE91-48	PR	0.0018	1.9965	0.00090
RE91-48	PR	0.0017	1.9964	0.00085
RE91-48	PR	0.0013	1.9963	0.00065
RE91-48	FW	0.0015	1.9978	0.00075
RE91-48	FW	0.0015	1.9975	0.00075
RE91-48	FW	0.0015	1.9972	0.00075
RE91-48	FW	0.0014	1.9973	0.00070
RE91-48	FW	0.0013	1.9969	0.00065
RE91-48	FW	0.0011	1.9978	0.00055
RE91-50	*RN*	0.0013	1.9985	0.00065
RE91-50	RN	0.0017	1.9982	0.00085
RE91-50	*NU*	0.0022	1.9969	0.00110
RE91-50	*RN*	0.0013	1.9984	0.00065
RE91-50	NU	0.0014	1.9973	0.00070
RE91-50	NU	0.0015	1.9973	0.00075
RE91-50	NU	0.0017	1.9978	0.00085
RE91-50	PR	0.0017	1.9960	0.00085
RE91-50	PR	0.0014	1.9968	0.00070
RE91-50	*FW*	0.0013	1.9982	0.00065
RE91-50	*FW*	0.0011	1.9987	0.00055
RE91-50	PR	0.0013	1.9971	0.00065
RE91-50	PR	0.0019	1.9971	0.00095
RE91-50	PR	0.0021	1.9967	0.00105
RE91-50	NU	0.0022	1.9978	0.00110

FISH ID	SAMPLE SITE	SR LEVEL	CA LEVEL	SRCA RATIO
RE91-51	FW	0.0007	1.9986	0.00035
RE91-51	FW	0.0009	1.9988	0.00045
RE91-51	FW	0.0010	1.9983	0.00050
RE91-51	FW	0.0015	1.9973	0.00075
RE91-51	FW	0.0012	1.9983	0.00060
RE91-51	FW	0.0011	1.9981	0.00055
RE91-51	PR	0.0018	1.9960	0.00090
RE91-51	PR	0.0020	1.9951	0.00100
RE91-51	PR	0.0022	1.9944	0.00110
RE91-51	PR	0.0022	1.9959	0.00110
RE91-51	PR	0.0023	1.9963	0.00115
RE91-51	PR	0.0023	1.9966	0.00115
RE91-52	FW	0.0010	1.9977	0.00050
RE91-52	*FW*	0.0010	1.9977	0.00050
RE91 -52	*FW*	0.0011	1.9972	0.00055
RE91-52	RN	0.0012	1.9971	0.00060
RE91-52	FW	0.0012	1.9973	0.00060
RE91-52	FW	0.0012	1.9977	0.00060
RE91-52	PR	0.0009	1.9960	0.00045
RE91-52	PR	0.0009	1.9969	0.00045
RE91-52	PR	0.0010	1.9946	0.00050
RE91-52	PR	0.0010	1.9963	0.00050
RE91-52	PR	0.0011	1.9964	0.00055
RE91-52	PR	0.0012	1.9938	0.00060
RE91-53	PR	0.0018	1.9751	0.00091
RE91-53	PR	0.0019	1.9732	0.00096
RE91-53	PR	0.0020	1.9747	0.00101
RE91-53	PR	0.0016	1.9725	0.00081
RE91-53	PR	0.0014	1.9766	0.00071

Appendix B. (continued)

FISH ID	SAMPLE SITE	SR LEVEL	CA LEVEL	SRCA RATIO
RE91-53	PR	0.0009	1.9757	0.00046
RE91-53	FW	0.0014	1.9779	0.00071
RE91-53	FW	0.0014	1.9766	0.00071
RE91-53	RN	0.0013	1.9775	0.00066
RE91-53	FW	0.0012	1.9779	0.00061
RE91-53	FW	0.0012	1.9763	0.00061
RE91-53	FW	0.0008	1.9916	0.00040
RE91-54	FW	0.0013	1.9979	0.00065
RE91-54	FW	0.0009	1.9974	0.00045
RE91-54	FW	0.0015	1.9979	0.00075
RE91-54	FW	0.0012	1.9979	0.00060
RE91-54	FW	0.0011	1.9982	0.00055
RE91-54	FW	0.0008	1.9972	0.00040
RE91-54	PR	0.0013	1.9976	0.00065
RE91-54	PR	0.0014	1.9970	0.00070
RE91-54	PR	0.0011	1.9963	0.00055
RE91-54	PR	0.0010	1.9967	0.00050
RE91-54	PR	0.0013	1.9970	0.00065
RE91-54	PR	0.0014	1.9972	0.00070
RE91-55	PR	0.0017	1.9976	0.00085
RE91-55	PR	0.0016	1.9982	0.00080
RE91-55	PR	0.0016	1.9978	0.00080
RE91-55	PR	0.0014	1.9984	0.00070
RE91-55	PR	0.0012	1.9982	0.00060
RE91-55	PR	0.0011	1.9985	0.00055
RE91-55	FW	0.0017	1.9976	0.00085
RE91-55	FW	0.0016	1.9984	0.00080
RE91-55	FW	0.0016	1.9971	0.00080
RE91-55	FW	0.0015	1.9978	0.00075

FISH ID	SAMPLE SITE	SR LEVEL	CA LEVEL	SRCA RATIO
RE91-55	FW	0.0014	1.9982	0.00070
RE91-55	FW	0.0013	1.9981	0.00065
RE91-56	PR	0.0017	1.9680	0.00086
8E91-56	PR	0.0016	1.9645	0.00081
RE91-56	PR	0.0015	1.9651	0.00076
RE91-56	PR	0.0015	1.9636	0.00076
RE91-56	PR	0.0014	1.9670	0.00071
RE91-56	PR	0.0009	1.9651	0.00046
RE91-56	FW	0.0018	1.9678	0.00091
8E91-56	FW	0.0016	1.9670	0.00081
RE91-56	FW	0.0015	1.9666	0.00076
RE91-56	FW	0.0014	1.9672	0.00071
RE91-56	FW	0.0011	1.9674	0.00056
RE91-56	FW	0.0008	1.9689	0.00041
RE91-57	PR	0.0018	1.9976	0.00090
RE91-57	PR	0.0016	1.9978	0.00080
RE91-57	PR	0.0015	1.9978	0.00075
RE91-57	PR	0.0013	1.9983	0.00065
RE91-57	PR	0.0013	1.9981	0.00065
RE91-57	PR	0.0012	1.9986	0.00060
RE91-57	FW	0.0013	1.9987	0.00065
RE91-57	FW	0.0013	1.9987	0.00065
RE91-57	FW	0.0011	1.9989	0.00055
RE91-57	FW	0.0010	1.9988	0.00050
RE91-57	FW	0.0009	1.9990	0.00045
RE91-57	FW	0.0008	1.9992	0.00040
RE91-58	PR	0.0016	1.9978	0.00080
RE91-58	PR	0.0015	1.9977	0.00075
RE91-58	PR	0.0013	1.9981	0.00065

Appendix B. (continued)

FISH ID	SAMPLE SITE	SR LEVEL	CA LEVEL	SRCA RATIO
RE91-58	PR	0.0013	1.9980	0.00065
RE91-58	PR	0.0012	1.9983	0.00060
RE91-58	PR	0.0012	1.9982	0.00060
RE91-58	PR	0.0012	1.9968	0.00060
RE9158	FW	0.0016	1.9979	0.00080
RE91-58	FW	0.0014	1.9985	0.00070
RE91-58	FW	0.0014	1.9984	0.00070
RE91-58	FW	0.0013	1.9986	0.00065
RE91-58	FW	0.0010	1.9982	0.00050
RE91-6B	PR	0.0014	1.9969	0.00070
RE91-6B	PR	0.0013	1.9968	0.00065
RE91-6B	PR	0.0011	1.9969	0.00055
RE91-6B	PR	0.0011	1.9971	0.00055
RE91-6B	PR	0.0012	1.9975	0.00060
RE91-6B	PR	0.0015	1.9965	0.00075
RE91-6B	FW	0.0013	1.9987	0.00065
RE91-6B	FW	0.0010	1.9975	0.00050
RE91-6B	FW	0.0007	1.9986	0.00035
RE91-6B	FW	0.0011	1.9983	0.00055
RE91 -6B	FW	0.0010	1.9990	0.00050
RE91-6B	FW	0.0014	1.9985	0.00070

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